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THE PURIFICATION OF WATER BY MEANS OF METALLIC IRON.

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[*A Paper read at the Stated Meeting of the* FRANKLIN INSTITUTE, *held Wednesday, March 19, 1890.*]

JOS. M. WILSON, President, in the Chair.

MR. DEVONSHIRE—MR. PRESIDENT AND MEMBERS OF THE INSTITUTE:

The purifying properties of the metal iron, and its beneficial action in the natural soil are well known. I desire this evening to explain to you a method by which these natural properties can be artificially applied to the purification of water. The great need of some practical method of restoring to their pristine purity sources of water supply, which have become elements of dangers and causes of disease to the numerous cities and populous centres which are

dependent upon them for the first and greatest of their daily requirements is, I think, sufficient apology for bringing the subject of my paper before your honorable INSTITUTE.

Dr. Medloch was probably the first who endeavored to make practical use of metallic iron as a purifier of water. He took out a patent in 1857 for a process in which iron wires or plates were to be suspended in tanks through which the impure water was to pass. In 1867, Dr. Thomas Spencer brought out a material which he named magnetic carbide, in which iron was the active reagent. Little, however, was accomplished on a practical scale previous to the invention by Prof. Gustav Bischof, of the material known as spongy iron.

Spongy iron is produced by heating hematite ore to a temperature of a little below that of fusion, and thus rendering it porous, or spongy in form. Dr. Bischof's material has long been utilized in domestic filters, and the spongy iron filter is at the present time second to none in its remarkable purifying properties, and in the permanence of its action during the whole period that the mass of the material remains porous.

In 1879, when a concession was obtained by an English firm for the construction of water works to supply the city of Antwerp, in Belgium, it was found that the only available source of supply was of such a nature that some method would have to be adopted to improve its appearance sufficiently to compete with that of the shallow well waters with which every dwelling in Antwerp was provided. The river Nethe, a tributary of the Scheldt, was the source selected. The water of this river is subject to various deleterious influences. It is colored with a yellow color, exceedingly difficult to remove, by the peaty nature of the country through which the river flows. It carries down at times large quantities of silt and finely divided clay. Being subject to the influence of the tide, it is affected by sewage pollution, both above and below the point where it was necessary to establish the in-take of the water works.

The commercial value of such water in a city so amply supplied with wells, as Antwerp, was from the first recog-

nized by the concessionnaires of the water supply as being very small, and it was decided to endeavor to artificially improve the water before sending it into the city. Bischof's spongy iron was the material selected as the most likely to give the desired results, and in 1879 an experimental spongy iron filter was erected at Waelhem, the site of the proposed works. Experiments were carried out on a considerable scale for several months, and gave most remarkably successful results, the impure and discolored water of the Nethe being changed into a bright, sparkling and chemically pure liquid. As a result of these experiments, permanent works were at once commenced, embodying Prof. Bischof's process. Three pairs of filters were constructed, each pair consisting of an upper basin containing a mixture of spongy iron and gravel three feet in thickness, and a lower basin containing a bed of river sand two feet thick. The river water was pumped into the upper basin, flowing through the bed of spongy iron on to the sand filter, where the oxide of iron was retained. The chemical results and the great improvement in the appearance of the water were all that could be desired, and for nearly two years it seemed that a practical process of purifying foul water on a large scale had been found. After a time, however, as the demand for water increased in the city, and the filters were required to approach their calculated output, it was found that the mass of the spongy iron mixture was caking together and becoming daily less porous. Matters at length became so serious that it was with the greatest difficulty that sufficient filtered water could be obtained to meet daily requirements. The spongy iron beds had to be dug over by manual labor, so as to loosen the material and restore in some degree its porosity.

After many expedients had been tried to overcome the mechanical difficulty of working these otherwise most efficient and valuable filters, it was pointed out by Sir Frederick Abel that means should be sought to keep the particles of iron in movement, so as to prevent their cohesion and also to maintain their surfaces clean and active.

The Consulting Engineer of the works, William Ander-

son, at the present time Director-General of Government Ordnance Factories in England,* after many experiments, hit upon the simple and ingenious plan of accomplishing the desired end by the invention of the apparatus known as the *Revolving Purifier*. Instead of allowing the water to flow downwards through a motionless mass of the purifying material, Mr. Anderson adopted as the principle of his invention *the showering down of finely-divided particles of the purifying material through a flowing stream of water*. A reference to the diagram will render the explanation of the apparatus easy of comprehension.

The apparatus (Plate I) consists of a cylinder *A*, supported in a horizontal position by hollow trunnions B^1 B^2, which are capable of revolving in pedestal bearings C^1 C^2. Attached to the internal periphery of the cylinder is a series of short, curved shelves *D D D*, arranged either in horizontal or diagonal rows at equal distances. A sixth row of curved shelves is replaced by a line of small square plates *H H H* which, by means of nuts outside the cylinder, can be set at an angle with the axis of the apparatus. By regulating the inclination of these plates, the shower of iron can be directed back to the inlet end of the purifier, and the tendency of the flow of water to carry forward the purifying material counteracted. Inlet and outlet pipes, *E* and *F*, enter the hollow trunnions and admit and discharge the water to be purified. As the water enters the cylinder it strikes against the circular distributing-plate *G*, and is caused to flow radially through an annular space five-eighths inch or three-fourths inch in width, the formation of a central current along the axis of the purifier being prevented by this means. The inner end of the outlet pipe carries an inverted bell-mouth *K*, which catches the fine particles of the iron carried forward by the water, and causes them to fall again to the bottom of the cylinder. One end of the cylinder is encircled by an annular spur-wheel *I*, working into gearing through which a slow rotary motion is given to the appa-

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ratus. On being started to work, sufficient metallic iron to fill one-tenth of the cylinder is introduced through the manhole, the iron being in a suitable state of subdivision. The purifier is then filled with water through the sluice-cock *L*, the air-cock *M* being left open to allow the cylinder to fill completely. The apparatus is then set in motion, the rate of rotation being about six feet per minute at the periphery. The effect of the rotation is to scoop up the iron particles and to shower them down through the flowing water.

When designing the original spongy iron filters, at Antwerp, the calculations of their size and capacity were based upon the opinion that, in order to obtain the best results, a contact of forty-five minutes between iron and water should be allowed. Following this idea, Mr. Anderson commenced by placing spongy iron in his revolving purifier and regulating the speed at which the water flowed through the cylinder so as to obtain a contact of forty-five minutes. It was at once evident that under these conditions the apparatus would have to be of such a size as to render it impracticable for any but small volumes of water. Experiments were, therefore, made to see whether the contact might not be shortened and, to the surprise of all concerned, it was found that a contact varying from three and one-half to five minutes was sufficient to effect the complete purification of great majority of waters. Under these altered conditions, the revolving purifier became of practical utility. Further, it was discovered that when used in the revolving purifier, spongy iron had no special merit; any form of waste iron, such as cast-iron borings or plate punchings, gave equally good chemical results and were in fact preferable to spongy iron, the irregularity of whose form interfered with one of the objects aimed at in the invention, viz: *the automatic and continuous renewal of the active surfaces of the particles of purifying material by causing them to rub one against another.*

As a result of this invention, the spongy iron filters at Antwerp were replaced by a battery of revolving purifiers, three cylinders of a medium size, and contained in a building 31 feet long by 26 feet wide, being found capable of doing twice the work of three spongy iron filters whose united

area was 24,000 square feet, and in which the spongy iron alone had cost $40,000.

The theory of what takes place in the revolving purifier and during the subsequent stages of the process is as follows:

The action on the iron in the purifier is one of reduction, the carbonic acid brought by the impure water dissolving a minute portion of the metal and forming a protosalt of iron. On issuing from the cylinder into the open air, the protosalt is gradually converted by the action of atmospheric oxygen into the insoluble form of ferric oxide (Fe_2O_3) with which we are all familiar under the name of iron rust. I need not remind any of my audience who have experience of house-keeping what are the destructive effects of iron rust on linen, the fibres of which are in general highly indestructible. The action of the ferric oxide in its nascent state in impure water is analogous to this and burns up, as it were, the organic matter. There is, however, a further action of very great importance, that of coagulation. In its formation, the ferric oxide encases in its flakes the finely divided matters held in suspension by the water, in many cases in a condition of such minute subdivision that they cannot be removed by the most efficient of mechanical filters. These matters are collected together or coagulated and form with the ferric oxide a flocculent precipitate of such a nature that it can readily be removed by rapid mechanical straining. The purification of the water is accomplished as soon as the whole of the protosalt of iron is converted into the insoluble form of ferric oxide, but to complete the process it is necessary, in the case of water intended for supplying a city, to strain out the precipitate. This is done by passing the water through filters composed of sand. Such filters may be as shallow in depth as will insure a homogeneous layer of sand. In the laboratory I have generally found three or four inches of sand ample to retain the iron precipitate, which forms a thin film on the top of the sand, leaving the lower portions of the filter perfectly clean. With large filters it would be impossible to maintain a homogeneous layer of sand as thin as this, and a depth of eighteen inches is desirable.

It will be seen that the revolving purifier is in no sense a filter and has no power of retaining any impurities in it. On the contrary, mud or other matters in suspension in the water pass freely through the cylinder, their bulk being added to it in a minute degree by the iron dissolved by the water. It is, therefore, evident that, in order to spare the sand filter, it is advantageous with waters of this description to retain as much as possible of the mud and finely divided matter in a settling trough or reservoir, to the bottom of which they will fall by their own weight when collected together into coarse flakes. Until the spring of 1889, the purified water at Antwerp flowed direct on to the sand filters along a shallow trough. Under those conditions the filters had to be cleaned on the average once a fortnight. Latterly, two subsiding reservoirs have been utilized for receiving the purified water before its filtration, and the sand filters now run six weeks without cleaning. An absolute distinction must be made between sand filters as utilized with the iron process and sand filters used alone in the ordinary way, as at London or Berlin. In the latter case, the sand bed, several feet thick, is looked to to effect, in some degree, the purification of the water. With this view the sand has to be frequently cleaned by washing it through its whole depth and exposing it to the air. With the iron process the sand serves only as a support to the film of iron oxide which it strains out of the water at its surface. It is well known how rapidly an ordinary sand filter will become foul through its whole depth; how, if water be forced through such a filter after a certain point of foulness has been reached, the filtered water will be worse than the unfiltered. With the iron process this is not the case. Purification is completed by the time the water reaches the sand. As a proof of this I may mention that sand filters have been at work at Antwerp for more than five years, that they have never been cleaned below the surface, and yet, at the present time, the water issuing from them contains no free ammonia at all and less than $\frac{1}{10}$ of a part in a million of albuminoid ammonia; the river water containing on the average $\frac{3}{10}$ of a part in a million

of each of these forms of ammonia. In the process of purification the aeration of the water as it leaves the revolving purifier plays a very important part. Purification can hardly be said to commence until the oxidizing action of the air begins the conversion of the protosalt into ferric oxide. To aid the natural aeration it is frequently advantageous to resort to artificial means by blowing air through the water. On Plate II, which gives a view of the general arrangement of purifiers at Antwerp, is shown a simple method by which artificial aeration may be accomplished. The first portion of the shallow trough which receives the water issuing from the purifiers is provided with a perforated false bottom through which air from a rotary blower rises in countless bubbles.

Time will not allow of describing the numerous applications of this process on the large scale to waters of very varied compositions, but I may state that the average results obtained are as follows: Firstly, all color is removed from water. Secondly, oxidizable organic matter, as measured by its power of reducing permanganate of potash, is reduced in proportions varying from forty-five to ninety per cent., according as the organic matter is principally of vegetable or of animal origin. Thirdly, free ammonia and nitrous acid are entirely removed. Fourthly, albuminoid ammonia is reduced from sixty to ninety per cent. Lastly, but in the opinion of, I believe, the majority of scientific men of the present day, most important of all, micro-organisms are entirely destroyed or removed by this process. As Resident Engineer and Manager of the Antwerp Water Works from the date of their construction, I have followed both the spongy iron process and the Anderson's revolving purifier in all their stages. Knowing what a remarkable standard of purity we had reached, I asked the Board of Directors of the company to appoint a commission of the most eminent chemists in Belgium to make weekly analyses of the water, both as to its chemical purity and as well as to its freedom from micro-organisms. This was done, and analyses were made weekly during the whole of last year by Prof. C. Blas, of Louvain University; Jorissen, of Liege University; Swarts

and Van Ermengem, of Ghent University. The last-named is recognized in Europe as a great authority on microbes. The examination of the water for microbes was made by Dr Koch's celebrated gelatine test, which is no doubt familiar to most present. Quarterly reports were made by the Commission, giving the results of the weekly analyses. Each of these reports stated that the very impure and dirty water of the river Nethe was transformed by the process of purification into a liquid equal, from a hygienic point of view, to the purest and most healthy spring water. I have here the final report of the Commission, which gives a *résumé* of the weekly analyses of the whole of the year 1889. The authoritative statements it contains are of such great importance that I may be permitted to translate extracts from it:

"The analyses were made every week, thus constituting a sort of permanent inquiry into the chemical and hygienic quality of the water.

"The concordant results of these numerous analyses have once more confirmed the opinion of all those who have studied the Anderson process of purification. This process, as applied at Waelhem, is of remarkable efficiency, the coefficient of purification is very high, and the water pumped into the Antwerp mains is irreproachable in every respect. The Nethe water, even after being deprived by twenty-four hours' settlement of the matter it holds in suspension, is yellow and thick, and opaque when examined through a depth of two feet. It has a flat taste. After a few days a deposit of brownish flakes forms in it. It shows an average of eighty milligrams of oxidizable organic matter to the litre, of 0·3 milligram of free ammonia, the same of albuminoid ammonia, and marked traces of nitrites.

"After purification, the water becomes limpid and brilliant in appearance. Its taste is fresh and agreeable; when seen through a depth of two feet it is transparent and of a pale green tint. After being kept for several months exposed to the light in bottles stoppered with cotton-wool, it remains perfectly limpid. This water contains, on an average, forty milligrams to the litre of oxidizable organic matter. The water never contains more than $\frac{1}{100}$ of a

milligram of free ammonia or one-tenth of a milligram of albuminoid ammonia in a litre. It is absolutely free from nitrous acid. The results of the bacteriological examination corroborate those of the chemical analysis. The purifying action of the Anderson process is here most manifest, as is shown by the almost total elimination of all micro-organisms. The water of the Nethe contains a great number of microbes. It may be estimated at an average of 50,000 colonies per cubic centimetre. After purification, water taken from taps in the city, and which has circulated through a great length of mains, contains an average of seventy-five colonies only. This number of germs is, indeed, small when compared to the number of micro-organisms which pass through filters reputed as the most perfect. But still fewer germs are found when the water is taken immediately on leaving the sand filters at the pumping station. Under the strictest conditions of experiment, we find that this water may be considered practically sterile. The number of colonies which it supplies varies from two to twenty per cubic centimetre. In no case has the Antwerp water supply disclosed the presence of bacteria of a suspicious or pathogenic kind, such as those of typhoid fever, for which search has been made with special care. It is, therefore, beyond all doubt that the process employed at the Waelhem Pumping Station offers the most complete guarantee that can be desired, in the present state of science, from the point of view of public health."

This is the result obtained under the ordinary conditions of the supply of a large city, and after the process has been continuously at work for five years. I think it may fairly be claimed for the Anderson process of purification that it has proved the possibility of overcoming and counteracting, in a practical and economical manner, the great objections which generally exist to drawing the water supply of cities from the most convenient and abundant source—that furnished by the rivers on whose banks the cities have grown up.

The revolving purifier is made in various sizes designated by the diameter of the inlet and outlet pipes. These range

from the one-inch apparatus, capable of treating 5,000 gallons to the fourteen-inch apparatus, which purifies 1,500,000 gallons per twenty-four hours. The power required for rotating the cylinder is very small, ranging from 690 foot-pounds per minute for the smallest purifiers to 28,500 foot-pounds for the largest. The quantity of metallic iron used up in the process varies with the nature of the water under treatment, and with the form of iron used. At Dordrecht, in Holland, where a fourteen-inch apparatus has been in use since 1886, the consumption of iron is at the rate of fifteen pounds per 1,000,000 gallons purified, "burrs" from punching machines being the form of iron used. At Antwerp cast-iron borings are mostly used, being readily obtainable. Owing to the nature of the Nethe water more iron is dissolved, and there is a considerable waste due to the breaking up of the friable particles of the metal in this form—the total loss being about six times that of Dordrecht. Cast-iron borings are, however, considerably cheaper than plate punchings.

When sand filters already exist, as is the case with the great majority of the European cities or towns, where the water supply is drawn from a river, the capital outlay involved in applying the revolving purifier process is approximately, $5,000 per 1,000,000 gallons required per day. When no sand filters exist, the further outlay for these varies considerably with local conditions, and with the size of the plant required. In cases where no settling basins are provided to catch the precipitate formed by the iron oxide, shallow filter beds are required of sufficient area to limit the speed of filtration to 100 gallons per square foot of sand surface per twenty-four hours. If the heaviest portions of the precipitate be arrested in settling tanks, the speed of filtration may be increased up to 200 gallons per square foot, or more with some classes of water, so that the cost of sand filters will be reduced in a more or less regular ratio to the extent of settling basins provided. For works whose output is small, say 3,000,000 or 5,000,000 gallons per day, the cost of sand filters, either with or without settling basins, may be estimated at $15,000 per 1,000,000 gallons of daily

consumption. The whole capital outlay, therefore, for applying the revolving purifier process to small water works, would be approximately $20,000 per 1,000,000 gallons of daily consumption. For larger quantities of water the cost per 1,000,000 gallons would, of course, be reduced.

The principal item of expense in working the revolving purifier process, is the periodical removal of the film of iron oxide from the surface of the sand beds. The cost of this may vary fifty per cent. or more, according to the provision made for arresting the precipitate by settlement in an open channel, or in a settling reservoir, before the purified water reaches the sand filters. It also varies somewhat with the nature of the water treated, the precipitate being of a finer nature in some cases than in others. At Dordrecht, in Holland, where the river water is charged with very finely divided clay, the precipitate forms with great readiness into coarse flakes, easily retained in an open trough provided with baffle boards placed six feet apart. There is no settling reservoir in this case, but the sand beds require cleaning once in three months only, the total working cost being slightly under $2 per 1,000,000 gallons, the maximum output of the works being 1,500,000 gallons per diem. At Antwerp, previous to the use of settling reservoirs before filtration, the cost including supervision was $4 per 1,000,000, calculations being based on an output of 2,000,000 daily. Of this sum $1 was for supervision, an item which would not be increased were the output ten times as great. The recent introduction of settling reservoirs has more than doubled the life of the filtering beds, and expenses are being brought down proportionately. It may be safely estimated that for quantities of 5,000,000 gallons per day and over, working expenses will in no case exceed $2 per 1,000,000 gallons.

Various methods are adopted for providing the small power required for the rotation of the apparatus. At Antwerp, motive-power is given by a steam-engine bolted to the wall of the purifier-house, and driving the five purifiers through a counter-shafting carried on wall brackets (Plate II). At Dordrecht, where there is a single purifier, capable of treating 1,500,000 gallons per day, the water issuing from

the cylinder actuates a reaction-wheel, which in its turn rotates the apparatus and at the same time drives a Roots air-blower.

Time allows me to give but a general description of this valuable process; more detailed information may be found by those interested both in the practical and scientific aspects which it presents, in the pamphlet published by me in 1888, and in the circular issued by the present holders of Mr. Anderson's patents, copies of which I have had the honor of presenting to your library.

It remains for me to express my most sincere thanks for the great kindness shown by the officers of this world-famed INSTITUTE, in allowing me, a foreigner, the privilege of reading this paper, and to thank you, Ladies and Gentlemen, for the kind way in which you have listened to me.

THE ELECTRICAL EXHIBITS AT THE UNIVERSAL EXPOSITION IN PARIS, 1889.

[*From the Report of Mr.* CARL HERING, *Delegate of the* INSTITUTE.]

ELECTRIC ORGANS.

Historical.—The first application of electricity to musical instruments having a key-board is said to have been conceived more than 100 years ago by a priest from Nivernais, named Jean Baptiste Laborde, but how it was to be applied, the record unfortunately does not state; it was, presumably, a mere vague prophecy. The real history appears to have begun in 1867–68, when an Englishman named Barker, aided by a barrister named Peschard, constructed the first electric organ in the church of St. Augustin at Paris. The principle appears to have been simply to open the valves of the organ pipes by electro-magnets, the circuits of which were closed by contacts at the key-board. This did not prove very satisfactory, owing to the large battery-power required, not only in the number of cells but also in their capacity. To overcome this important objection, Messrs. Schmoele & Mols, of Philadelphia, devised an

ingenious relay system, called the electro-pneumatic system, in which the function of the electro-magnets was not to open the valves themselves, but merely to open a small aperture under the valves, which admitted the compressed air used to blow the organ, which in turn opened the valve; thus the force required by the magnets was very small, the actual work of opening the valves, and moving the mechanism for the different stops, being done by the compressd air with which every organ is already supplied.

General.—In general in an electric organ there is a contact connected with each key and stop of the key-board, a wire for each leads the current to the respective pipe or stop mechanism which actuates electro-magnets there, which in turn operate directly or indirectly the pipes and stop mechanism. The advantages of electric organs, over those operated by purely mechanical means, are as follows: The only connection between the key-board and the pipes being by means of electric conductors, the key-board and the pipes may be placed any desired distance apart, and either of them may be placed in any convenient part of the church or building, irrespective of where the other is placed; the same key-board may also be used for several different organs, separately or together, by means of a simple switch putting the battery on either one or the other organ or both together; or there may be several key-boards for the same organ; the key-board may be moved about, being connected merely by a flexible cable. This electric conductor takes the place of, and dispenses with, all the complicated levers, pins, wires and angle pieces, which are otherwise necessary to connect the key-board with the pipes, and which, being very complicated, are apt to get out of order and to be affected by moisture, dryness and dust, causing variation in their action. The force required by the player in depressing the keys, being merely to close a small contact, is practically nothing. The key-boards, stops, etc., can be brought into as small a compass as desired, thereby making it easier for the player.

Organ Exhibited.—There was only one electric organ at the exhibition. It was exhibited by Messrs. Merklin & Cie,

(French Section,) and made in accordance with the patents of the American inventors Messrs. Schmoele & Mols. The organ proper was in two parts, placed at the two ends of the upper gallery, while the single key-board was in the centre of the main floor below. The system was that called the electro-pneumatic system, mentioned above.

Valve Mechanism.—The mechanism for opening the valves and for working the mechanism of the stops may be briefly described as follows: The valve is attached to the movable part of what might be termed a small pair of bellows directly below it, and in the same compressed air chamber. The compressed air normally presses on both the inside and outside of this bellows, and, therefore, does not actuate it. The action of the electro-magnet is simply to open a small aperture of this bellows, allowing the inside to communicate with the open air; the pressure of the compressed air on the outside of the bellows consequently closes it, and being attached to the valve, it pulls it open, forming with it a sort of balanced valve. The force required by the electro-magnet is, therefore, very small; the armature weighs only a gram (fifteen grains) and its movement is only one millimetre (one twenty-fifth of an inch). All the mechanism of the stops, no matter how heavy, is actuated in the same way by a sort of bellows larger in the same proportion as the work they have to do, and controlled electrically by a very small magnet.

Contacts.—As the current used is very small, the contacts may be made very simply. They consist of small, flat springs of german-silver, which are attached to the lever of the key, and slide over a fixed contact piece, thereby cleaning themselves each time they move. In the older systems of electric organs in which the valves were opened directly by the magnet, the currents necessary were so great that the contacts had to be made with mercury cups and wires dipping into them.

Battery.—Five Lalande & Chaperon cells are said to be sufficient for a large organ and will not need attention more than once in several years. In one of their organs at Lyons, four of these cells were used; the box containing

them was not opened for three years, during which time they did not fail once. The cost of recharging them is very slight, amounting, it is claimed, to only forty to sixty cents a year.

Cost.—The cost of the electric organs is stated to be the same as that of mechanically operated ones.

KNITTING-MACHINE IN WHICH THE DESIGN IS PRODUCED BY ELECTRICAL MEANS.

Among the weaving and knitting-machines was one exhibited by Emmanuel Buxtorf (French Section), in which the design, in two colors, was produced by a very simple electrical contrivance attached to the ordinary machines. It is a very good example of a case in which a very simple electrical attachment to a machine will perform an operation which would require a very complicated apparatus to do mechanically, if it could be done at all.

The machine is for making material like that for jerseys, hosiery, etc., which is made in the form of a cylinder and is woven of a single thread, which is knitted on by a continuous circular movement of the knitting mechanism, similarly to the way in which a stocking is knit. The design of two colors is produced by using two threads of the two colors, side by side, in place of the single one, being, therefore, practically the equivalent of a single thread the two sides of which are colored differently. These are led to the needles side by side so that one of them hides the other, therefore making one side of the material one color, and the other side the other color. By merely interchanging the relative position of these two threads, a design of two colors is produced, the one on the back being the negative of the design on the face. This interchanging of these two threads is effected by means of two light guides, which are moved by an armature of a small electro-magnet, which is attracted or released according as one or the other colored thread is to form the face of the material. The current for this magnet is made or broken by a contact-pin sliding over the surface of a small rotating brass cylinder on which the design has been painted with thick shellac or other insu-

lating compound. Whenever the pin passes over the shellac, the circuit is broken. This design cylinder is rotating in exact correspondence with the cylinder of material which is being woven, and has also a corresponding axial motion, so that the position of the contact-pin on the design cylinder corresponds exactly to the place on the material where the thread is being woven into it. The exact place where the threads are to be interchanged corresponds, therefore, to the place where the current is made or broken by the design of shellac on the brass cylinder. By rotating this design cylinder two or three times as fast, the design will be produced in two or three places respectively on the material; by increasing or diminishing the axial motion of the design cylinder, the design will be shortened or elongated respectively on the material, producing quite different effects. The original design is evidently not limited in any way as to its shape, outline, irregularity or simplicity. Owing to the nature of the weaving, the color on the back of the material shows through slightly on the face, making the design slightly less definite and prominent.

The operation of weaving a colored thread into such material was done before by mechanical means, but it was limited to geometric patterns, and the mode of weaving in the colored thread rendered the material inelastic.

AUTOMATIC WEIGHING MACHINE, OPERATED ELECTRICALLY.

Among the weighing machines was one called the Snelgrove electric weighing machine, exhibited by Messrs. W. & T. Avery (British section), in which the operation of adjusting the sliding weights on the steelyard or beam was performed automatically by electrical means. The object of this machine is to combine the accuracy, reliability and great capacity of the lever or beam scale with the self-indicating advantages of the spring balance. All that the operator needs to do is to place the objects to be weighed on the platform of the scales, and read off the numbers on the dials when the steelyard has come to rest.

As the construction of the automatic apparatus for adjusting the weights, is very complicated and intricate,

perhaps more so than is necessary, nothing more than a general description of the principles of this operation will be given here. In *Engineering*, June 21, 1889, there are some good working drawings of one of these scales, differing only slightly from the one exhibited; the accompanying description, however, is not very clear.

The general construction of the scale is that of the usual platform beam scales, having two sliding weights, one small and the other large. The whole of the operating mechanism is on the beam itself; this is an essential feature. At the free end of the beam in place of the usual stops for limiting its movements, are two electrical contacts, one above and one below the beam; the upper one causes the weights to advance on the beam, and the lower one causes them to recede; one or the other of these contacts will therefore be closed as long as equilibrium has not been reached, and the mechanism will not come to rest, even if it has made a mistake, until the beam rests between the contacts, when qeuilibrium has been reached. In a scale for 500 klgr. the small weight will adjust itself in steps of ½ klgr. up to 10 klgr., and the large weight in steps of 10 klgr. up to 500. The adjusting weights are pushed forward by a small fixed electric motor on the beam; they are brought back by springs. In placing the goods to be weighed, for instance 86·5 klgr., on the platform, the beam will move up and close the upper contact; this starts the motor which pushes the small weight out to the extreme end, registering 9·5 klgr.; on arriving at the end of the beam it closes another contact which causes the large weight to be pushed out in steps of 10 klgr., until *over balance* is reached, which in this case would be at 80, therefore registering altogether 89·5 klgr.; this causes the beam to tilt and to close the lower contact; this in turn relieves the small weight, which moves *back* by a step-by-step escapement until exact balance is reached at 6·5, when the beam will rise, open the circuit and rest between the two contacts. On taking off the load, the beam falls, closes the lower contact, which releases the small weight, which, when it arrives at zero, closes a contact there that releases the large weight. It will be seen from this,

that should the machine make a mistake by moving the large weight too far, the automatic action will be to bring both back to zero and make them start over again from the beginning. The weights cannot come to rest until equilibrium has been attained. A weighing is stated to require from six to twelve seconds, while two to three seconds are required for the return of the weights to zero. For ordinary intermittent work, a battery of large Leclanché cells has been found satisfactory.

A number of difficulties in an electric scale of this sort are overcome by the ingenious idea of making the small weight move *first*, to the extreme end of the beam, then moving the large weight out to overbalance, and finally moving the small one *backwards* to the required position. This operation is the reverse of the natural one in adjusting by hand.

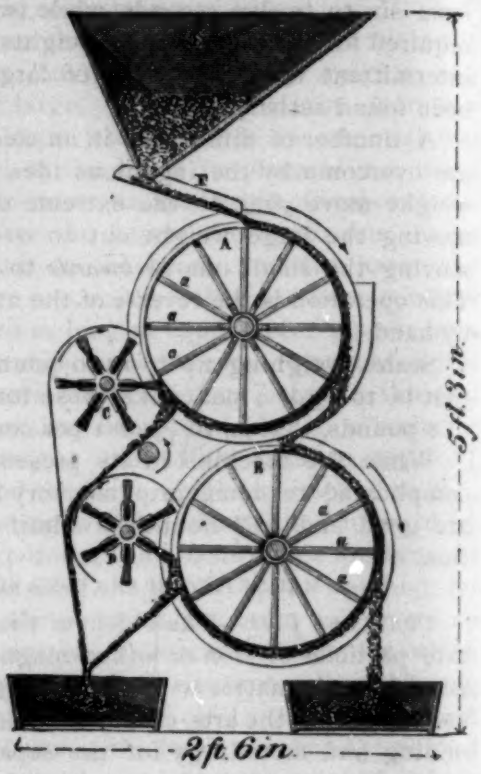
Scales weighing up to 1,000 pounds, adjust to a pound, that is, to $\frac{1}{10}$ of 1 per cent.; those for 40,000 pounds adjust to 8 pounds, that is, to $\frac{2}{10}$ of 1 per cent.

While the machine in its present form is probably too complicated to come into use very largely, the principles are good and will doubtless admit of a simpler construction.

MAGNETIC SEPARATORS OR SORTERS.

Object and Uses.—The object of these machines is to separate particles of iron or other magnetic matter, from any non-magnetic matter with which they are mixed. They are used largely in the arts, chiefly for the following purposes: In mining and metallurgy for the separation of the mineral magnetite or magnetic iron ore, from its accompanying minerals; in machine shops and foundries, to extract the iron from filings and turnings and chippings (an operation which is often done by hand, but which is very injurious to the health of the workman on account of the fine copper and brass dust); in flour mills to extract fragments of iron from the grain; in the manufacture of white zinc oxide, to extract magnetic impurities; in numerous industries, to extract pieces of iron from crude materials to which they have been fraudulently added to increase the weight.

General Principle.—The general principle of all these machines is that the material in the form of sand, powder, or small particles, is made to pass over or near powerful magnets which attract the iron particles or the magnetic iron ore, and allow all the other materials to pass by, thus affording a very good, simple and reliable means of effecting a separation.



There were three of these machines exhibited, one each from France, United States and Belgium, differing only in the manner in which this principle was applied.

Details.—Mr. Chas. Vavin (French section, bronze medal) exhibited the machine shown in the adjoining cut. The material falls on the two drums, as shown. Each drum is made of four wheels; the spokes *a a* of these wheels are permanent magnets, having their like poles at the circumference, and there connected in common to an iron ring which, therefore, forms one of the magnetic poles on the surface of the drum. The four wheels of a drum are alternately of north and of south polarity, forming, therefore, strong magnetic fields all over the surface of the drums. The material falls, as shown, over these drums revolving at the rate of thirty-two revolutions per minute; that which is magnetic attaches itself to these drums and is brushed off

by the revolving brushes *C C*. The object of two drums is to repeat the operation to make the separation more thorough. This is probably necessitated by the fact that permanent magnets are at their best not very strong. Its working capacity is said to be 660 pounds per hour; its requires one-sixteenth of a horse-power, and can be turned by hand. There are over 500 of them in use. It has the great advantage over the others in that no battery or dynamo is required to generate the magnetism, as the magnets are permanent. It appears to be used chiefly in machine shops.

The Edison sorter consists simply of a hopper and a huge electro-magnet. The material falls continuously, in form of a sheet, from a long, narrow slot in the bottom of the hopper, and in its fall it passes by and near to the pole of the large magnet, but does not touch it; that material which is not magnetic falls perfectly vertically, while that which is magnetic is attracted toward the magnet, and is thereby deflected from its vertical course, falling on the other side of a partition which separates it from that which falls vertically. The advantages are that the process is very rapid and requires no power except the current for the magnet. The disadvantages are that a battery or a dynamo is required and that only a certain class of material, such as sand, can be made to fall in front of the magnet in the form of a thin sheet. Probably for this reason, it appears to be used chiefly in mining, for separating the magnetic iron ore from its accompanying minerals. It is claimed that by this means black sand, found in so many places, as well as other iron ores which are too poor to be worked by other methods, can be worked to great advantage by this machine.

In the sorter of Jaspar, exhibited by Eschger, Ghesquière & Cie (Belgian section) the object seems to be to obtain an exceedingly intense magnetic force and it appears to be used chiefly in the manufacture of zinc and zinc oxide. It consists of two iron horizontal rollers, side by side and almost touching each other, somewhat resembling crushing rollers. The ends of these rollers, next to their bearings, pass through fixed coils of wire through which a current is

passed, which magnetizes them so that the one roller is a north pole at the exposed portion between the coils, and the other is a south pole. The narrow space between them is, therefore, an exceedingly intense field. The material is made to pass between these rollers at this place, the rollers turning in the opposite sense than if they were intended to crush the material. The magnetic particles, therefore, attach themselves to these rollers, are carried out over the rollers and scraped off by means of scrapers, while the non-magnetic material falls through the space between the rollers. As the bearings must necessarily be magnetized by this disposition of parts, there will doubtless be considerable friction produced. Its capacity is stated to be 4,400 pounds per hour, and it requires two horse-power.

DEPTH OF FOCUS IN PHOTOGRAPHIC LENSES.

By William A. Cheyney.

In a paper published in the JOURNAL OF THE FRANKLIN INSTITUTE (November, 1889), I stated that what is called depth of focus in a photographic lens depended for its seeming existence upon the inability of the unaided human eye to detect an error, in sharpness of the image on the ground glass, of $\frac{1}{200}$ of an inch or less. And that what is known as the constant focus is dependent on this same inability to detect, and is the depth of focus when the lens is focused upon an object at a certain distance from the the lens.

This distance, I stated, was a matter of calculation, and gave the formula for said distance as follows:

$$\frac{af}{e} + f$$

And I further stated that when a lens was accurately focused upon an object at the distance so found, all objects beyond a point at one-half that distance from the lens would be in apparent focus, which last distance is represented by the formula:

$$\frac{af}{2e} + \frac{f}{2}$$

Now, in order to derive these formulæ, I call your attention to *Fig. 1*:

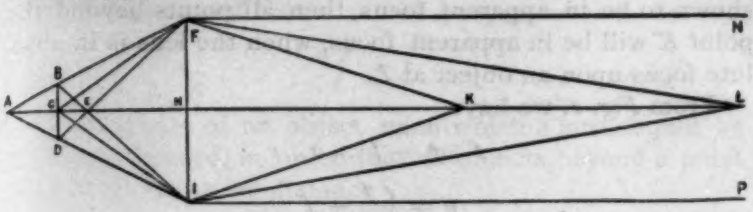


FIG. 1.

$E\ H = f$ = focus for parallel rays $F\ N$ and $I\ P$ = equivalent focus of lens.
$B\ D = c$ = greatest imperceptible error.
$F\ I = a$ = aperture of lens = diameter of diaphragm.
$C\ H = p$ = lesser conjugate focus with object at L.
$H\ L = p_1$ = greater " " " " L.
$A\ H = p_2$ = lesser " " " " K.
$H\ K = p_3$ = greater " " " " K.

Here we have the parallel rays $F\ N$ and $I\ P$ from an object infinitely remote, which, after passing through the aperture of the lens $F\ I$, and being refracted, meet at the point E, where they would make an absolutely sharp image on the ground glass. But the ground glass is made to take such a position back of the point E that the rays that would make a mathematical point at E cross each other and form a blurred spot on the ground glass not greater than $\frac{1}{100}$ of an inch in diameter, here represented by the line $B\ D$.

Now, the point C in said line being the point of absolute sharpness or the rays $F\ L$ and $I\ L$ coming from an object at L, all objects between the point L and a point infinitely distant beyond L will be an apparent focus.

Just as the foregoing is true of the rays coming from a point infinitely distant and crossing, so it is true of the rays $F\ K$ and $I\ K$ coming from an object at K, and which would meet at the point A after having passed through the ground glass, but which do not make an error in focus on the ground glass greater than $\frac{1}{100}$ of an inch in diameter, here represented by the line $B\ D$.

Therefore, all objects between the point K and the point

L will be in apparent focus, and as all objects between the point L and a point infinitely distant beyond were above shown to be in apparent focus, then all points beyond the point K will be in apparent focus, when the lens is in absolute focus upon an object at L.

From *Fig. 1*, we have

$$f : p - f :: a : e$$

$$p = \frac{e f}{a} + f$$

and from the law of conjugate foci—

$$\frac{1}{f} = \frac{1}{p} + \frac{1}{p_1}$$

$$p_1 = \frac{f p}{p - f}$$

substituting the value of p, as found above—

$$p_1 = \frac{a f}{e} + f.$$

Now, p_1 being the length of the line $H L$, determines the point L upon which the lens must be focused, in order that all objects beyond the point K shall be in apparent focus.

Also, from *Fig. 1*, we have

$$p_2 - p : p_2 :: e : a$$

$$p_2 = \frac{a p}{a - e}$$

substituting the value of p, as before—

$$p_2 = \frac{f (a + e)}{a - e}$$

Again, from the law of conjugate foci—

$$\frac{1}{p_3} = \frac{1}{f} - \frac{1}{p_2}$$

$$p_3 = \frac{f p_2}{p_2 - f}$$

substituting the value of p_2, as found above—

$$p_3 = \frac{a f}{2 e} + \frac{f}{2}.$$

And p_3 is the length of the line $H K$, and is one-half of the former distance as before stated.

Thus, it is shown that

$$\frac{a f}{e} + f$$

is "the distance of an object upon which a lens should be accurately focused, in order that all objects beyond a point one-half of the above distance"

$$\left(\frac{a f}{2 e} + \frac{f}{2}\right)$$

"shall be apparently in focus." And

$$\infty - \frac{a f}{2 e} + \frac{f}{2}$$

will be the depth of focus when the object focused upon is at the distance

$$\frac{a f}{e} + f$$

from the lens.

In order to derive the formula for the depth of focus of a lens when the object focused upon is at a less distance from the lens than

$$\frac{a f}{e} + f$$

I refer you to *Fig. 2.*

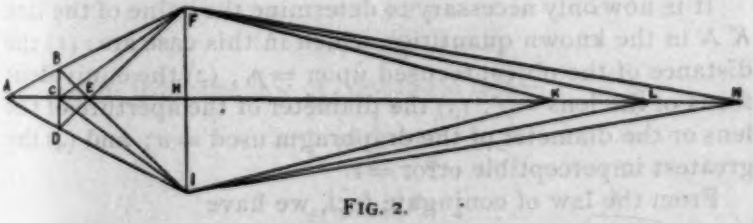


FIG. 2.

f = equivalent focus of lens (not shown in figure).
$C H = p$ = lesser conjugate focus, with object at L.
$H L = p_1$ = greater " " " " L.
$A H = p_2$ = lesser " " " " K.
$H K = p_3$ = greater " " " " K.

$E\,H = p_4$ = lesser conjugate focus, with object at N.
$H\,N = p_5$ = greater " " " " N.
$F\,I = a$ = aperture of lens = diameter of diaphragm.
$B\,D = e$ = greatest imperceptible error.
$K\,N = df$ = depth of focus.

Here we have an object at L from which the rays $F\,L$ and $I\,L$ come and pass through the aperture of lens $F\,I$, and, being refracted by the lens, come to absolute focus at C.

And the rays $F\,N$ and $I\,N$ from an object at N also pass through the aperture $F\,I$ and are refracted, they then cross each other at their focal point E and continue on to the ground glass on which they fall with an error of $\frac{1}{250}$ of an inch or less in diameter, here represented by the line $B\,D$.

Also, the rays $F\,K$ and $I\,K$ from an object at K pass through the aperture $F\,I$, and are refracted by the lens, but before they reach their focal point A, they are arrested by the ground glass with an error of $\frac{1}{250}$ of an inch or less, also represented by the line $B\,D$.

Now, it is evident that in this case all objects between the point K and the point N will apparently be in focus when the lens is accurately focused upon the point L. Or in other words, the depth of focus of the lens will be represented by the line $K\,N$, when the object focused upon is at a distance from the lens represented by the line $H\,L$ and the aperture represented by the line $F\,I$.

It is now only necessary to determine the value of the line $K\,N$ in the known quantities, which in this case are: (1) the distance of the object focused upon $= p_1$; (2) the equivalent focus of the lens $= f$; (3) the diameter of the aperture of the lens or the diameter of the draphragm used $= a$; and (4) the greatest imperceptible error $= e$.

From the law of conjugate foci, we have

$$\frac{1}{p} = \frac{1}{f} - \frac{1}{p_1}$$

$$p = \frac{f\,p_1}{p_1 - f}$$

and from *Fig. 2*, we have

$$p_2 - p : p_2 :: e : a$$

$$p_2 = \frac{a\,p}{a - e}$$

substituting the value of p, as found—

$$p_2 = \frac{a\,f\,p_1}{(p_1 - f)\,(a - e)}$$

again, from the law of conjugate foci, we have

$$\frac{1}{p_3} = \frac{1}{f} - \frac{1}{p_2}$$

$$p_3 = \frac{f\,p_2}{p_2 - f}$$

substituting the value of p_2, as found above—

$$p_3 = \frac{a\,f\,p_1}{a\,f + e\,p_1 - e\,f}$$

being the greater conjugate focus of the lens when the object is as near as possible to the lens without showing a perceptible error in focus.

From *Fig. 2*, we also have

$$p - p_4 : p_4 :: e : a$$

$$p_4 = \frac{a\,p}{a + e}$$

substituting the value of p, as before found—

$$p_4 = \frac{a\,f\,p}{(p_1 - f)\,(a + e)}$$

and again from the law of conjugate foci—

$$\frac{1}{p_5} = \frac{1}{f} - \frac{1}{p_4}$$

$$p_5 = \frac{f\,p_4}{p_4 - f}$$

substituting the value of p_4, as found above—

$$p_5 = \frac{a\,f\,p_1}{a\,f + e\,p_1 - e\,f}$$

being the greater conjugate focus of the lens when the object

is as far as possible from the lens without showing a perceptible error in focus, from which p_3 must be deducted to find the depth of focus of the lens.

$$df = p_2 - p_3 = \frac{a f p_1}{a f - e p_1 + e f} - \frac{a f p_1}{a f + e p_1 - e f}$$

$$= \frac{2 a e f p_1 (p_1 - f)}{a^2 f^2 - e^2 (p_1^2 - f [2 p_1 - f])}$$

From which we see that the equivalent focus of a lens varies according to the relation between the length of its equivalent focus, the distance of the object focused upon, and the diameter of the diaphragm used. The greatest imperceptible error being constant.

For example, we are using a lens having an equivalent focus of twelve inches, with the *f*/4 stop and with the object to be photographed fifteen feet from the lens. Then taking $\frac{1}{200}$ of an inch as the greatest imperceptible error, we have

$$f = 12 \text{ in.}, \quad a = 3 \text{ in.}, \quad e = \tfrac{1}{200} \text{ in. and } p_1 = 180 \text{ in.}$$

then

$$df = \frac{2 \times 3 \times \frac{1}{200} \times 12 \times 180 \times (180 - 12)}{9 \times 144 - \frac{1}{62500} \times (32400 - 12 \times [360 - 12])}$$

$$= 6{\cdot}7 \text{ in.}$$

Here we have very little depth of focus and, in order to increase it, we must be further from the object, or decrease the size of the diaphragm used or both.

But to take a case that occurs oftener than the above, we use a lens of eight inches equivalent focus with the *f*/4 stop and with the object to be photographed eighteen feet from the lens, then we have

$$f = 8 \text{ in.}, \quad a = 2 \text{ in.}, \quad e = \tfrac{1}{200} \text{ in. and } p_1 = 216 \text{ in.}$$

$$df = \frac{2 \times 2 \times \frac{1}{200} \times 8 \times 216 \times (216 - 8)}{4 \times 64 - \frac{1}{62500} \times (46656 - 8 [432 - 8])} = 22{\cdot}5 \text{ in.}$$

Here by the changes that we have made, we have increased the depth of focus over three-fold, and had we used the *f*/8

stop, we would have increased it nearly seven times, thus—

$$df = \frac{2 \times 1 \times \frac{1}{250} \times 8 \times 216 \times (216 - 8)}{1 \times 64 - \frac{1}{62500} \times (46656 - 8\,[432 - 8])} = 45{\cdot}4 \text{ in.}$$

Again, let us take the same lens, use the *f*/16 stop and make the distance to the object focused upon eighty-four feet, the same as given in the table for "constant focus" in my former paper, and we have

$$f = 8 \text{ in.}, \quad a = \tfrac{1}{2} \text{ in.}, \quad e = \tfrac{1}{250} \text{ in. and } p_1 = 1008 \text{ in.}$$

Now, take the first formula for depth of focus—

$$df = \frac{afp_1}{af - ep_1 + ef} - \frac{afp}{af + ep - ef}$$

$$= \frac{\frac{1}{2} \times 8 \times 1008}{(\frac{1}{2} \times 8) - (\frac{1}{250} \times 1008) + (\frac{1}{250} \times 8)} - \frac{\frac{1}{2} \times 8 \times 1008}{(\frac{1}{2} \times 8) + (\frac{1}{250} \times 1008) - (\frac{1}{250} \times 8)}$$

$$= \frac{4032}{0} - \frac{4032}{8} = \infty - 504 \text{ in.} = \infty - 42 \text{ feet;}$$

or, in other words, all objects beyond forty-two feet from the lens, will be in apparent focus, as is given in the above-mentioned table.

In all these calculations, I have taken $\frac{1}{250}$ of an inch as the greatest imperceptible error, because it is, approximately, the sine of the angle of one minute, when the radius is fourteen inches, which latter is about the distance from the eye, at which we hold a photograph when looking at it; and the angle of one minute is imperceptible to the unaided human eye.

CHEYNEY, PA., March 19, 1890.

[Entered according to Act of Congress in the year 1890, by Thos. Pray, Jr., in the Office of the Librarian of Congress, Washington, D. C.]

WHAT DOES A STEAM HORSE-POWER COST?

BY THOS. PRAY, JR., M.E., C.E., Boston.

[*A Lecture delivered before the* FRANKLIN INSTITUTE, *December 20, 1889.*]

The Lecturer was introduced by PROF. COLEMAN SELLERS, and spoke as follows:

MR. CHAIRMAN, MEMBERS OF FRANKLIN INSTITUTE AND LADIES AND GENTLEMEN:

The topic for this evening is one that connects the pocket-book with the moving power, and the determination of the cost of power is neither a simple matter nor one of ready reference in results. The problem has occupied the time and talents of many of the most illustrious men of the nineteenth century, and it has made these names revered because of the fidelity with which their self-imposed tasks have been performed, and from their labors, from the results they have left for us, we are enabled to know something of the physical properties of heat, water, steam and work. These ever varying elements are now subject to the man who studies them, and who uses his knowledge wisely for the benefit of mankind, and in so many ways that an enumeration is unnecessary.

When Prof. Sellers and your Secretary, Dr. Wahl, selected this topic, they had, I presume, taken into account the fact that one hour would only allow a looking at the subject from only a single point; but when they coupled with the subject the qualification to make it non-scientific for the benefit of the younger men who were learning something of steam, its uses (and perhaps its abuses), they did not simplify the matter, for a simple presentation of such a subject cannot be made so quickly or comprehensive, as one that embraces the calculus and the brief but extensive formulæ in concise form.

Uneducated men seriously misjudge those who have enjoyed the opportunity of education by supposing that the explicit and concise formulæ is employed to confuse those who do not understand it; while the sole reason it is employed by scientific men is only and exactly to *save time* to make the *clearest* possible statement or demonstration in the least space, words and minutes. To reduce some of the terms employed, to make a few comparisons from actual fact only, and to introduce the fundamental computations at first will be my purpose, and to explain somewhat the methods employed for the younger members, and then to interest all by a few tables of actual facts in which no terms of importance are omitted, nor any self-interest terms are left to conjecture, to mislead the honest seeker after either facts or information as the means of benefiting himself by learning the method of computation. To put this into one hour is equal to reading *Webster's Unabridged* in an hour upon its merit. We must then look up the subject and how to approach it. The screen slide No. 1 shows you certain recognized units all determined years ago, and re-determined with precision by different men at different times and in different countries.

The so-called testing of an engine and boiler is not the easiest thing to do correctly unless an honest purpose is a part of the motive. Men who mean to do just right are so often prejudiced in wanting to accomplish some especial result that they become dishonest in action by being *biased*. The man who searches for the fact must have judicial impartiality, more than judicial fairness in hearing, by observing, recording and computing, facts only, and with all corrections carefully included, for few of the material substances of this earth are constant in value, because subject to physical changes by heat and cold or friction, etc.

Frequently the self-interest comes in in the way of using a particular grate bar, gauge cock, steam gauge, indicator, or some other fixture or accessory, and then again we must learn to use these matters correctly, for very frequent instances of a lack of knowledge or disposition to properly apply an instrument come to the knowledge of the observer

of facts. In short, a man to attempt a test must be honest with himself, must disabuse himself of all preconceived ideas, and submit himself simply as a medium of measuring, weighing, counting and recording, in order to compute afterwards and render honest account of results, without one particle of personal wish, favor or prejudice entering into the problem or results.

The factors necessary are all to be brought out later on. Coal is certainly one of them, quality and condition must be noted, but "pounds of coal per horse-power" is no more a measure of cost of a horse-power than the boy's "piece of chalk," and one is exactly as definite as the other, just as reliable, convenient we will grant, but meaningless, indefinite, totally unreliable, as a means of comparison. "Pounds of water per pound of coal" is another meaningless expression, if given alone or without qualification. An amusing instance of this happened a few months ago in a very elaborate document presented to the New England Cotton Manufacturers' Association, where a hundred or more evaporative tests were given, but so far as my own looking them through went, but two gave the quality of the steam from a calorimetric point of view. We hear frequently of *great results* in evaporation, but to my own mind there is a great gap, unless the determination of the actual amount of water in the steam is also given. "Pounds of water per pound of coal," without the rest of the information is always misleading, if not called by its proper name, for pounds of water can be and frequently are carried over in the steam, and unless the calorimeter shows that amount, we may as well call it "steam and water," but that would not look well on the circulars. The calorimeter is capable of determining very closely and quickly the real value of steam if properly used, and it is also capable of misleading you if you do not work *exactly*. The man who says "about right" is eternally wrong, always wrong, and never correct, and when temperature, weight and a second temperature and time and second weight are to be taken. it must be done quietly, very accurately, and unless done so exactly, results are not worth the time spent, and had better be thrown away or guessed at

entirely, and some of the so-called calorimeters, or modifications, or improvements shown and used, if they were called worthless, would be recognized instantly by some of the professors in our physical laboratories, who don't write certificates at so many dollars each or give recommendations for worthless affairs, not worth half a cent each, compared with our honest if homely old barrel without some "expert" patent.

Coal, water and quality of steam are the essentials of the boiler or generating apparatus. Feed water in amount, NOT by meter, but by the actual weight, then the temperature, and we are ready to study the engine, its connections and the general deductions regarding it, and its action and use of the steam generated by the boiler.

Connecting the two, we have a *steam plant*, and any steam user knows well that, given an engine and boiler, at given speed under constant load, and supplied with steam at a constant pressure as nearly as can be, a certain constant quantity of steam will be called for, if nothing gets out of place. But the amount of coal consumed may vary by large amount, not entirely by value or quality of coal, or its percentage of waste, but in the "personal equation" of the man or men in charge of the fire-room, or the water feeding, and other necessary mechanical manipulations that enter into the producing a horse-power for the most uncertain factor of all is "the man."

The modifications of the results are not within any narrow limits even with constant load and conditions. Then the idea of high grades of expansion engines entirely unfitted to the load, and the worst abuse of steam known to man is the back-pressure fallacy with throttling engines where a low range of temperature is effected by short range of expansion—and a back pressure of over five pounds above the atmosphere—in some cases fifteen or twenty pounds plus the 14·69 or thirty to thirty-five pounds absolute. Men have amused themselves in this way, using a steam engine as a "reduction valve," to use their expression, getting their "power for nothing," and "have all the steam left" for manufacturing purposes.

This idea has been called "a proper use of latent heat," and under certain conditions may be advisable, but the idea will be shown in all its enormity on the screen shortly, where facts are illustrated. Given an engine fairly adapted to the load, cutting off at about one-sixth and expanding from five to five and one-half times and a back pressure of one atmosphere plus five pounds can be and is employed with advantage, if the percentage of back pressure does not amount to over fifteen to twenty per cent. of the load. But when an engine uses steam as so many do to-day, where the initial pressure is only ninety or ninety-five pounds absolute, and the terminal is sixty-five to seventy pounds absolute, the measure of expansion is a very low ratio, and the percentage of back pressure from twenty-five to forty-five per cent. of the load; the results are far from economical—Carnot's law —Slide No. 3, of the range of temperatures, as the measure of efficiency, and Rankine's efficiency rule, are of far more importance than steam users allow, if, indeed, they give it any thought, and this was the fundamental law of the Corliss engine—to obtain the greatest range of pressure—within a certain limit of expansion and then waste the steam at lowest terminal pressure possible, with the utmost expedition, and no country on earth to-day where steam is used can be found where Corliss engines are not largely used. The exact difference is, simply stated:

Corliss *opened a large valve wide open*, held it a sufficient time to overcome the load at correct speed, and shut the valve as speedily as possible, expanding as near to a terminal pressure of an atmosphere as could be, and exhausted free. The usual engine chokes the steam pressure to an amount that will do its work by a fixed distance of cut-off, and usually exhausting at a higher terminal pressure, exhausting more or less freely as the case may be, using a vastly larger quantity of steam for the same horse-power under close approach to same conditions. Mr. Corliss used a slow speed of steam in his ports, rarely exceeding 6,500 feet per minute, and it is not a rare thing in my own practice to find engines of very modern construction from ancient designs, where the speed of steam is 13,000 to 15,000 feet per

minute, and through the ancient and venerable slide valve slow in its opening and closing, increasing the speed in ports far above the figures mentioned even for a part of the time, but there is another and important factor, the friction of the engine alone. Corliss engines in my care require three and one-half I.H.P. to run a 700 horse-power engine at full speed. Throttle wide open, no belts on:—and 125 horse-power engines running within two miles of where I am now standing, use nine to eleven horse-power under the same circumstances; all these matters are of serious import in the summing up of our question.

The use of steam to make a horse-power is so modified by these conditions that we find in one case an engine running under twenty-five pounds of steam per horse-power per hour, and in another fifty, sixty, seventy pounds of steam required with this back-pressure argument used, but if we compute the cost of the two and condense the first one, we get from eighteen to twenty pounds or about one-third the amount used for power, and two-thirds of "hot" steam with the smallest amount of water present, with which to do twice as much work over and above the equivalent work, and under the best conditions as to results. Few men would buy coal at $7 per ton when they could buy it at $2.33 of same quality and pounds. Yet they use three times or far more the steam they need to, except in the one case they gratify their "one idea," and one of the most amusing as well as absurd instances of this was the trial of two United States ships some years ago in New York, one to be run with a "cut-off" or high grade of expansion, to demonstrate the superiority of that "idea." The figures are not at my hand at the moment, but the result was a disastrous defeat of the correct system because of the "idea," about the worst form of valve was used, the "cut-off" was a success, but the expansion line left a terminal pressure almost as high as the lower rate of expansion in the other engine, and economy was sacrificed by leaky valves, poor vacuum, etc., but the "idea" was there, first, last and always.

We have some curious instances of steam plants in the various "electric" enterprises now in existence, high speed,

high terminal pressure, and a vibration of all the real estate within 1,000 feet, that is amusing if not comforting, and a rarity of dividends equal to some railroad stocks you are not unfamiliar with in Philadelphia. The high speed engine is all right in its proper place and under proper conditions, and no man in the United States is more to blame for their introduction and use than myself, having been intimately connected with them since 1870, not, however, in the abuses of them in ill adaptation so practised in the electrical misuses, but men who put up steam plants from which to make money need as much as four weeks' experience to plan them and adapt them, and should have another week or two in which to learn that familiarity born of experience for success in the operation of such plants.

Builders of engines sometimes study results, and sometimes do not do so. Cause and effect may be ignored, but the result is as sure as death.

Experience is somewhat a necessity in using steam, and a man or firm who cannot profit by some of their experiences are to be pitied more than blamed. A steam plant should be laid out to do a certain thing, and all means used to accomplish the objective point.

Preference and prejudice are exceedingly unreliable factors to introduce, but are commonly present. We must study the facts, profit by failures, and be guided by the successes as well. No lack of excellent engines, boilers and accessories in this country to-day. We can make a horsepower cheap if only natural laws are observed, not discarded; facts by comparison are valuable, and I shall now proceed to go over the most intimately connected facts with the cost of the I.H.P., as well as some of the reasons why such an extravagant amount of cost follows the misuse or abuse of our servant, steam-power.

Heat is the source of all life, all motion is life, and inaction is cold, lack of heat or death in a physical sense. The laws of heat, its production and transfer are very few and simple, and like all the material substances God has given us for our use and benefit, His and their laws are easy to understand, being simple in the extreme, and the failures of

mankind are generally and very directly traceable to an attempt to discard some of the laws so plain and simple.

We know that it requires a certain and specified heat to melt ice, to boil water, and we also know that after water is boiled and confined that if we add a certain number of heat units to the vapor of water that we have steam under a pressure higher or lower, and that we can and do have a temperature due to pressure. We also know that when we have made our steam, we cannot use it in any way without constant loss, for we can add as many increments of heat as the boiler will stand pressure, but the instant we set it in motion for any purpose whatever, then we lose portions of the heat and the steam begins its return to its original state of water. We also know that if we observe certain laws, we can use the medium of steam with only a small loss of heat, and the smaller the loss, naturally the higher the efficiency we attain, these facts are recorded in Regnault's researches. Rankine has expounded the practical application of law and constants, as no man before or since, and many others have aided in researches to verify these laws, notably Prof. Rowland, of Johns Hopkins University, who more than any other American has investigated, only to prove Regnault and Rankine to have done their work in accordance with the utmost refinement physically, and the deductions are mathematically correct, and practically applicable and reliable, a host of other names could be mentioned. The Library of the FRANKLIN INSTITUTE is full of them, I presume, volume after volume, and these researches have extended over sixty-two years, or from 1827, when Sadie Carnot opened up the mine which has so far proved inexhaustible.

Any man can learn this if he will, it is not secret, occult or mysterious, and the man who can make a horse-power cheaply, is not often in search of a job. "There is plenty of room up-stairs" in steam or any other of the professions.

The compounding craze is now in fashion, and my time will not permit much to be said of, it. It is a new application of an old idea, and like the measles, must have its run. Steam can be expanded *too* many times, and expansion can

be so expanded in practical work, that it costs more than the simple compound. It is only another of the ideas, and will ultimately drop out of its present rush, and the happy medium be found.

The compound engine, as triple or quadruple expansion, is a cumbersome affair, parts are multiplied and true a higher *rate* of expansion obtained, but if we come back to Carnot's law and Rankine's efficiency. The many-headed compound engines now in use have an efficiency of from forty-two per cent. up to rarely over sixty per cent., when steam pressure, volume, ratio and expansions are all considered. I do not mean forty-two to sixty per cent. of the *theoretical*, but forty-two to sixty per cent. of the *practical* result that such an engine should give from the high pressure carried, and the volume, and expansion ratios of the cylinders.

Some curious instances of these engines have come into my hands, not all marine engines by any means, and some of the very largest steamers afloat to-day have been all investigated, changes made so far as was permissible, and yet we find the speed of steam in ports, 18,000 feet for steam of forty pounds gauge pressure, and 13,000 feet for six to ten pounds of gauge pressure, and when Rankine's rules are applied we find twelve to fifteen per cent. loss in high eighteen to twenty-four in mean, and twenty-five to forty in the low-pressure cylinder, and in many cases now afloat a properly constructed simple compound with a high and two low-pressure cylinders, with speed of steam proportioned to piston speed would exceed in efficiency any compound triple expansion engine afloat to-day. It is not an unusual thing to use twenty-four to twenty-seven pounds of steam per horse-power per hour, to-day on these so-called improved engines, the loss of initial pressure is from ten to forty pounds; clearances are *enormous*, yet they are in fashion.

The compound engine, non-condensing, is also being tried, an amusing instance, and an expensive one as well, being the compound locomotive. Of course, the stockholders do not complain when the "Luxury" is put in the round-house for repair, and years roll on without improvement.

The world would retrograde you may say, but when so-called improvements are built upon violation of physical laws so well known as the properties of steam, and then the real results so carefully concealed, we may judge with propriety that success did not attend the results, or to call it properly, we say failure did attend.

Making money is a pretty good profession, and a man to make money in the use of steam-power has a great many things to learn, many claims of saving twenty to fifty or some other per cent., which are perhaps honestly stated, but which are preposterous when put to actual test. A man may save twenty per cent. of the bulk of steam, and not two per cent. of heat units. He may waste one-third of his steam and yet do his work by another engine and waste forty per cent. and do his work with one-half the coal he did in wasting one-third the steam. He can add his back pressure so that his engines become a reducing valve, and so save it all. But by changing engines he can easily do the same horse-power with one-third the steam, and boil two times as much soap, or oil, dye vats, sugar or other article of manufacture, actually doing three times the work with the same coal as was done before.

This will be shown you on the screen, and not a single figure will be given from any source except my own work, and in each the result will be put in dollars and cents.

WHAT DOES A STEAM HORSE-POWER COST?—NO. 1.

One pound lifted one foot high, or one pound of force acting through one foot of distance, equals one foot-pound or one unit of work. Thirty-three thousand foot-pounds, or units of work, lifted one foot high in one minute of time, equals one horse-power.

Indicated horse-power means power exerted after sweeping out the exhaust.

Net or effective horse-power is the dynamometer measurement from a belt or shaft, and represents the power of engine to do useful work outside of the engine itself.

Five hundred and fifty foot-pounds per second $\times$ 60 = 1 horse-power or 33,000 pounds. Pounds of pressure or the

piston surface in square inches of area, multiplied by the number of feet the piston travels per minute divided by 33,000 gives the indicated horse-power, or force × by space to which force is applied, × by distance in feet per minute ÷ by 33,000 = horse-power for the stated or observed conditions, only and for that moment.

Unreliable data, "multiply cylinder diameter in inches by stroke in inches and divided by four"—"multiply the mean effective pressure in pounds per square inch by double the piston speed in feet and by the square of diameter of piston in inches, point off five places from the right," "call the mean pressure forty pounds." "The cube root of the stroke in feet × by the square of diameter of cylinder in inches and divide by sixty." "× the cube root of stroke in feet by square of diameter of piston and ÷ by 20." "× velocity of piston of feet per minute by the diameter in inches squared ÷ 6,000."

Still No. 1 is briefly stated in the first four paragraphs, the basis of what makes a horse-power. Force and time or force, time and distance are the whole number of elements. We say a pound a foot a minute, and a pound lifted a foot equals a unit of work, and 33,000 pounds a foot high in a minute equals James Watts' unit of a horse pulling his load, the equivalent of 33,000 pounds in one minue, or one horse-power, and if we apply our inquiries to the piston head, we have the area of the piston to replace the horse cart, and the steam to substitute for the pull of the horse, and the speed of piston backwards and forwards in feet per minute in place of the walking of the horse, so we must multiply the square inches of the piston's area by the actual mean exerted pressure of steam on the area in pounds, and that by the number of feet per minute, then divide this product by 33,000 pounds and the result equals the horse-power for that stated train of conditions and instant only.

We may estimate the pressure, but to gather the facts the indicator must be used, and correctly. The last paragraph of No. 1 shows some *exceedingly* "unreliable data."

Take the first so-called rule, twelve inches diameter, twenty-four inches stroke, then $12 \times 24 = 288 \div 4 = 72$

horse-power. Now, take same problem with a longer stroke, $12 \times 36 = 432 \div 4 = 108$ horse-power, showing its absurdity on its face, no speed, no mean pressure, no correctness in its result. The next two are unworthy your attention, except to show that such so-called rules exist. The last two show old and now obsolete rules for nominal horse-power—no use in modern practice.

[*To be continued.*]

On SCHOOLS: with PARTICULAR REFERENCE to TRADES SCHOOLS.

By Joseph M. Wilson, A.M., C.E.
President of the Franklin Institute.

[*Continued from vol. cxxix, p. 394.*]

SCHEDULE FOR NEEDLE-WORK.

N. B.—The materials and the stitches of the exercises performed before the Inspector or in the garments shown to him, should not be so fine as to strain the eyesight of the children.

GIRLS' AND INFANTS' DEPARTMENTS.

Below Standard I.

Needle drill.—Position drill.

Strips (18 inches by 2 inches) in simple hemming with colored cotton, in the following order, viz: one black, two red, three blue.

Knitting-pin drill.

A strip knitted (15 inches by 3 inches) in cotton or wool.

Standard I.

(1) Hemming, Seaming, Felling.—Any garment or other useful article, which can be completed by the above stitches, *e. g.*, a child's pinafore, pillow-case, or pocket-handkerchief. In small, mixed country schools, strips (18 inches by 2 inches) of hemming, etc., may be shown, at the discretion of the managers, in place of a garment.

(2) Knitting.—Two needles, plain, *e. g.*, a strip on which to teach darning in upper standards, or a comforter.

Standard II.

(1) The work of the previous Standard with greater skill. —Any garment or other useful article as above.

(2) Knitting.—Two needles, plain and purled, *e. g.*, muffatees.

Standard III.

(1) The work of the previous Standards, stitching, and sewing on strings.—Garment, a pinafore, shift or apron.

Herring-bone Stitch.—The stitch only on canvas or flannel.

Darning, simple, on canvas.

(2) Knitting.—Four needles, plain and purled, *e. g.*, muffatees.

Standard IV.

(1) The work of the previous Standards, gathering, setting-in, button-hole, sewing on button.—Garment, a plain night-shirt, night-gown, or petticoat.

(2) Marking, simple, on canvas.

(3) Darning, plain (as for thin places) in stocking web material.

(4) Knitting.—Four needles, a sock.

(5) Herring-bone.—A patch (at least 3 inches square) on coarse flannel.

Standard V.

(1) The work of the previous Standards, and the running of a tuck.—Garment as in Standard IV.

(2) Knitting.—Four needles, a sock or stocking, ribbed or plain.

(3) Plain darning of a hole in stocking-web material.

(4) Patching in calico and flannel.

(5) Cutting out any garment, such as is required in Standard III.

Standards VI and VII.

(1) The work of previous Standards, whip-stitch, and setting-on frill.—Garment, a baby's night-gown or child's frock.

(2) Darning, plain, on coarse linen.

(3) Patching in print.

(4) Knitting.—Four needles, a long stocking, with heel thickened.

(5) Cutting out any undergarment for making up in Standard IV.

NOTES.

(1) Garments must be shown in each Standard, but not necessarily those specified in this schedule, which are mentioned merely as examples. They must be presented in the same condition as when completed by the scholars.

(2) At least half as many garments must be shown as there are children on the books in Standards I and II. Each garment must be entirely made by its own Standard. In Standard III and upwards, each girl must (as a rule) present a garment made by herself.

(3) Girls should be encouraged to cut out garments for the lower Standards at least, and to fix their own work in the garments shown. Those above Standard I will be required to "fix" and "cast on" in the exercise performed before the inspector.

(4) Girls attending cooking classes during any of the hours devoted to needle-work shall be exempt from presenting a garment to H. M. Inspector.

PUPIL-TEACHERS (GIRLS).

First Year.

(1) A chemise or a night-shirt, showing all the stitches required in Standards IV and V.

(2) A hole correctly mended (common method) in stocking material.

(3) Paper patterns (cut out and tacked together) of two garments, suitable for children, in Standards III and IV.

(4) A sock.

Second Year.

(1) An infant's night-gown or a child's mull muslin frock, showing all the stitches required in Standards VI and VII.

(2) A patch in calico, one in flannel, one in print.

(3) Patterns of a boy's shirt and a woman's night-gown, drawn to scale (one-fourth size) on sectional paper; quantity and quality of material to be stated.

(4) A stocking.

Third Year.

(1) A tucked flannel petticoat or an infant's long flannel.

(2) A three-cornered (or hedge-tear) darn, and a cross-cut (or diagonal) darn, on coarse linen.

(3) Paper patterns (cut out and tacked together) of a pair of child's drawers and a child's frock bodice.

Fourth Year.

(1) A sample in calico, showing all the stitches required in the making and mending of calico garments.

(2) A sampler in flannel, showing the stitches used in the making and mending of flannel garments.

(3) Diagrams on sectional paper drawn to scale (one-fourth size) of a chemise (full size) and a night-shirt (full size).

NOTES.

(1) In all cases, the specimens, garments and drawings shown to the inspector must be done without assistance, and presented as they left the worker's hands. All garments must have been cut out by the makers.

(2) No embroidery is to be used. The garments should be of plain patterns, showing intelligence and good workmanship, but without elaborate detail.

THE SCHOOL BOARD FOR LONDON.

The School Board for London originated in 1870, under the Elementary Education Act of that year, and elections to the board are held every three years.

The main divisions of the board's work consist:

(1) In determining the amount of school provision which is required for the metropolis;

(2) in providing accommodation to meet any deficiency which may be found to exist;

(3) in enforcing the attendance of children at school;

(4 and 5) in managing the public elementary schools

established by the board, whether day-schools or evening-schools.

(6) in bringing before the magistrates children who are liable to be sent to an industrial school, and in managing any industrial schools established by the board;

(7) in providing for the supply of books and apparatus to the schools of the board;

(8) in making inquiries with reference to any educational endowments which may be made available for the elementary instruction of the children of London, and, finally,

(9) in providing the funds or raising the loan necessary for the board.

The work covered by these various divisions is delegated to the following standing committees, subject to the ultimate sanction of the board:

(1) Statistical and Law and Parliamentary Committee.
(2) Works and General Purposes Committee.
(3) By-laws Committee.
(4) School Management Committee.
(5) Evening Classes Committee.
(6) Industrial Schools Committee.
(7) Store Committee (providing for supply of books and apparatus).
(8) Minuting and Educational Endowments Committee.
(9) Finance Committee.

The number of children of the elementary school class reported as scheduled by the visitors, March 31, 1888, was as follows:

Aged three to five,	166,295
five to seven,	163,499
seven to thirteen,	433,936
Total, three to thirteen,	763,680

The amount of permanent school accommodation existing and projected in March, 1888, was:

	Places.	
Existing board schools,	396,703	
Non-board schools,	262,022	
Total,		658,725
Projected,		48,872
Total places,		707,597

A certain percentage must be deducted from the enumeration to represent all causes of absence, and it was estimated for the same year that the total number of school places required was 610,944. The above figures do not include any children over the age of thirteen, of whom some attend school voluntarily and others can, by law, be compelled to attend. The number of children over thirteen years of age attending public elementary schools in London in 1888 was 24,595.

The Elementary Education Act of 1870 provided that when the managers of non-board schools were unable, from lack of funds or other cause, to continue their schools, they might transfer them to the board. Between 1871 and 1888, 143 such schools, accommodating 46,978 children, were transferred to the board. One hundred and twenty-four of these schools were closed, and the children drafted into new permanent schools erected by the board, the balance remaining open as board-schools.

The chief duties of the Works Committee consist in the purchase of sites for the schools. The new buildings and enlargements of old buildings are in charge of this committee. The permanent *cookery centres* of the board are at present built upon an uniform plan, and consist of a room about 21 x 18 feet, fitted with gallery or stepped seats, to seat thirty children, and the necessary apparatus for demonstrating, such as a counter, a gas stove, a kitchener, an open range stove, a dresser, etc.; a scullery with sink, and a lavatory and cloak-room, the whole being detached from the school building wherever possible.

Pupil-teachers' centres are being erected. Each of these centres contains six class-rooms for the accommodation of mixed classes of thirty-six male and female students; a large hall 44 feet 6 inches by 30 feet, not counted in the accommodation of the school, but fitted up with desks and used for examinations, etc.; a chemical laboratory; rooms for teachers and superintendent, and also a drawing class-room, a covered gymnasium and an open gymnasium on the top of the building.

The schools now being planned are provided with covered

play-grounds so arranged that they can with little expenditure be adapted as *technical class-rooms*, workshops, etc. Similar provisions have also been made with existing schools.

The principal duty of Committee No. 3 is to enforce the attendance of children at efficient schools, whether non-board or board. Under the Act the board were empowered to make By-Laws governing this question. The following is the existing law:

(*A*) *As to Children Between Five and Thirteen.*

A child between five and thirteen years of age must attend a certified efficient school during the whole time for which such school is open.

Exceptions:

(*i*) A child between ten and thirteen years of age is not required to attend school for more than five attendances in each week, if such child shall be shown to the satisfaction of the School Board to be beneficially and necessarily employed, and shall have received a certificate from one of Her Majesty's Inspectors that it has passed the *Third* Standard.

(*ii*) A child between ten and thirteen years of age is not required to attend school at all, if such shall have received a certificate from one of Her Majesty's Inspectors that it has passed the *Sixth* Standard.

The following are reasonable excuses for the non-attendance of a child at school:

(*a*) That the child is under sufficient instruction in some other manner.

(*b*) That the child is prevented from attending school by sickness or any unavoidable cause.

(*c*) That there is no public elementary school open which the child can attend within two miles.

The parent or guardian of any child, who ought to attend, but does not attend school, is liable upon conviction by a magistrate to a penalty not exceeding, with the cost, five shillings for each offence.

Moreover, the employer of any child, who ought to attend,

but does not attend school, is liable to a penalty not exceeding forty shillings for each offence.

(*B*) *As to Children Between Thirteen and Fourteen.*

No parent, or other person, may have in, or take into his employment, any child between thirteen and fourteen years of age, unless such child, (*a*), shall have obtained a certificate that he has passed the *Fourth* Standard, *or* (*b*), shall have made 250 attendances in not more than two schools during each year for five preceding years, whether consecutive or not.

The employer of a child between thirteen and fourteen years of age, who has not satisfied one of these two conditions, is liable to a penalty not exceeding forty shillings, and if such child is habitually absent from school, the parent is liable to successive penalties of five shillings each.

The average attendance at school for the year ending Lady-Day, 1888, was—

Board-schools, ...	328,578
Non-board schools, ...	162,349
	490,927

The duties of the School Management Committee (No. 4) comprise the transaction of all business relating to the management and discipline of the day-schools of the board and to the instruction given in the schools. This committee has also under its charge, the classes for the blind and for the deaf and dumb, and also the central schools for the instruction of pupil-teachers. It reports upon the appointment and removal of teachers and their salaries, and upon the fees to be paid by the scholars in each school. Every school provided by a School Board must be a public elementary school, within the meaning of the Elementary Act of 1870, and, therefore, must be conducted in accordance with the conditions concerning elementary schools—of which previous mention has been made. With one or two exceptions, the subjects taught in the London Board Schools are those laid down in the code of the Education Department on and after April 1, 1887. Drawing ceased to be a "class"

subject under the code of the Education Department, and reverted to the supervision of the Science and Art Department.

Vocal music, although not technically known as a "class" subject, is taken throughout the schools.

Drill and Swedish exercises are used in the schools for the purpose of physical training. Simple gymnastic apparatus is also provided in the play-grounds of nearly all the schools for the use of children during certain hours of the day.

Drawing is now a compulsory subject of instruction in all boys' departments, and in mixed departments it is compulsory for the boys but optional for girls. Special drawing classes have been established at the Saffron Hill School, Farringdon Road, and at the Monnow Road School, Bermondsey, where selected boys and girls receive instruction in drawing, and also in modelling in clay.

Needle-work.—In the first scheme drawn up for instruction in this branch, the board inspectors were held responsible for proper inspection of needle-work, and were empowered to ask the assistance of ladies on the management of the different schools, or, where this was not practicable, to call in other assistance. Afterwards it was found necessary to have a special officer for this work, and there are now two examiners of needle-work engaged by the board.

Cookery.—The first suggestion in reference to teaching of cooking was made in June, 1874, and in 1878 the first cookery class-room was decided to be erected. There were on Lady-Day, 1888, fifty-five such class-rooms and others were sanctioned.

"Four courses of cookery lessons are given during each year, beginning in January, April, July and October, and ending, respectively, in June, September, December and with regard to the October course, in March of the following year." "Every girl is expected to attend one-half day in each week during a course, and must make at least twenty attendances." "To facilitate the completion of twenty attendances within a course, each course consists of twenty-two lessons." "If a girl does not complete her twenty les-

sons in one course, she is required to attend once every week during the next course, until she has received them." "The number of children on the roll to attend a centre for any one lesson is limited to thirty."

Cookery centres are, as a rule, open daily (Saturdays excepted) from 9·15 A.M. to 12 noon, and from 2 to 4·30 P.M. To obtain a mark for punctual attendance, girls must be in their places at 9·15 A.M. and at 2 P.M. This is the only mark that counts for a prize or medal, but attendances are recorded until 9·30 A.M. and 2·10 P.M.; after 9·45 A.M. and 2·20 P.M. admissions are not allowed. No extra fee is charged for those attending board-schools, and children from non-board schools can attend for instruction upon payment of a fee of four shillings each for the course of twenty-two lessons, one lesson each week. During the year 1888, 223 non-board scholars received instruction in cookery at the board's centres.

Prizes, such as cookery receipt-books, or useful cooking utensils not exceeding one shilling each in value, are awarded to girls who have made twenty attendances within the course, sixteen of which must have been *punctual* marks. The cooked food is sold, whenever possible, to the children or teachers.

For the week ending October 26, 1888, there were 12,505 children on the roll, and 10,655 in actual attendance; but as a course is only six months in duration, these numbers represent only about one-half the children instructed during the year.

[*To be continued.*]

THE METALLURGICAL ARTS AT THE PARIS EXHIBITION.

By F. LYNWOOD GARRISON,
Delegate of the INSTITUTE.

[*Continued from vol. cxxix, p. 374.*]

COAL AND COKE.

PRODUCTION OF COAL AND COKE IN FRANCE IN 1887, COMPARED WITH 1877.*

Coal-fields.	*1877.* tonnes.	*1887.* tonnes.
Northern coal-field,	6,720,000	11,317,000
Loire coal-field,	3,340,000	2,989,000
Gard coal-field,	1,660,000	1,831,000
Burgundy and Nivernais coal-field,	1,380,000	1,497,000
Central coal-field,	1,020,000	994,000
Aveyron and Tarn coal-field,	975,000	1,076,000
Auvergne coal-field,	240,000	291,000
Herault coal-field,	238,000	208,000
South Vosges coal-field,	186,000	186,000
Creuse and Corrèze coal-field,	178,000	153,000
Western coal-field,	237,000	136,000
Western Alps coal-field,	132,000	132,000
Total for coal and anthracite,	16,305,000	20,810,000
Provençe and Alps brown coal-fields,	470,000	457,000
Sundry brown coal-fields,	30,000	21,000
Total for brown coal,	500,000	478,000
Sum total,	16,805,000	21,288,000

N.B.—The French *tonne* is 1,000 kilograms.

* *Journal of Iron and Steel Inst.*, No. 2, 1889, p. 11.

PRODUCTION IN 1888.*

	1888. Coal.
North:	
Nord and Pas de Calais,	12,364,085
Centre:	
Loire,	3,357,817
Saône-et-Loire,	1,611,057
Allier,	988,529
Isère,	128,700
Cher,	—
South:	
Gard,	1,827,707
Aveyron,	809,567
Ardèche,	—
Ariège,	—
Pyrénées-Orientales,	—
Total production,	22,380,813

The output of the French collieries for the first half of the year 1889 is stated to be as follows: †

Coal and anthracite, 11,696,020 tons, an increase of 835,085 tons over the first half the year 1888. Lignite, 210,954 tons, a decrease of 5,842 over the first half of the year 1888.

It will be observed that the output of coal in France has increased about 40 per cent. since 1887, and that this increase has been nearly altogether in the Northern coal-fields.

The coal consumption of France having been 31,191,000 tons for 1887 (instead of 24,144,490 tons for 1877), the foreign imports must have been 10,565,000 tons (including 4,046,000 tons of British coals), instead of 7,882,000 tons (including 2,867,000 tons of British coals), for 1877.

It will be observed from the above figures that the coal consumption in France in 1887 was more than a third greater than the total output of the French collieries. The importations for that year amounted to 10,565,000 tons, of which about half was British and the balance, I suppose,

* *Iron Age*, September 5, 1888, p. 371.

† *Bulletin du Comité des Forges*, No. 249, pp. 55–57.

Belgian and German coal. I regret I have no figures of the importations for the later years, but I understand the amount has been steadily increasing each year.

Owing to the rather distorted condition of many of the French coal-fields much of the output is broken up into such a fine condition that it cannot be used for ordinary purposes unless mixed with much coarser coal or combined with pitch and compressed into blocks. The manufacture of these blocks or *briquettes*, as they are called, has become quite an extensive industry in France. A number of the French coal companies had extensive displays of machinery for this purpose at the exhibition. Without going into detail, it will suffice to say that the industry is a rapidly developing one on the continent of Europe, and the indications are, that before long some similar system will be adopted to utilize the enormous waste heaps in the anthracite regions of our country.

The great *Northern coal-field* is represented in the Exhibition by the Anzin, Aniche, Escarpelle, Douchy, and Vicoigne collieries, situated in the department of the North, and by the Lens and Douvrin, Courrières, Bethune, Noeux, Bruay, Dourges, Fléchinelles, Lievin, Meurchin, and Drocourt collieries, situated in the Pas de Calais.

The *Loire coal-field* is represented by the four more important mining companies, viz: the Montrambert and Beraudière Company, the Loire Company, the St. Etienne Company, and the Roche-la-Moliére and Firminy Company. The coal-field, as a whole, is illustrated by an interesting plan in relief.

The several collieries of the *Gard coal-field* exhibit a very fine geological plan in relief of the coal-field as a whole, and each of them, viz: the Grand Combe, Bessèges, Portes and Senechas, Rochebelle, Trelys, Cessous and Comberedonde, Salles and Montalet has also its individual exhibits.

The *Burgundy and Nivernais coal-field* is represented by the beautiful exhibit of the Blanzy collieries, and by the geological maps of the Decize colliery (owned by Messrs. Schneider & Co.).

The *Central coal-field* has sent plans in relief of the Saint

Eloi and of the Bezenet collieries, as well as models of the Commentry colliery, prepared so as to illustrate the delta theory of coal-field formations put forward by M. Fayol.

The *Aveyron collieries* are represented in the metallurgical gallery by the plans and drawings of the Aubin mines; and the *Tarn collieries* in the "Palais des Machines" by the exhibits of the Carmaux Mining Company, and of the Tarn Mining Society.

The *Ronchamp colliery*, in the South Vosges, exhibits its plans and products.

The *Graissessac mines* (Herault) are represented in the "Metallurgical Gallery," as well as the *Bouches du Rhone lignite collieries*, which exhibit the brown coals of Greasque and the Rocher bleu.*

Coke.—Most of the coke produced in France is made in improved ovens such as the *Coppée*, *Smet*, *Carvès*, etc. The vertical *Appolt* ovens are now but little used; they are only to be seen at Blanzy, Creusot and Bezenet. The almost obsolete beehive ovens are used at only one or two collieries, the coke made in them being mostly used for foundry purposes. Messrs. Seybel & Bernard displayed at the Exhibition a number of drawings of improved coke ovens, especially intended for coking of poor coals.

The application of coke ovens to the production of tar and ammoniacal salts does not seem to have met with much success in France, for the reason, it is said, that the quality of the French coals is not so well suited to the production of by-products as the English and German coals.

Iron Ore.—The consumption of iron ore in France in 1877 and 1887 is classified as follows:

	1877. *tons.*	*1887.* *tons.*
Native,	2,346,000	2,298,000
Algerian,	330,000	48,000
Foreign,	647,000	1,107,000
	3,323,000	3,453,000

* *Journ. Iron and Steel Inst.*, No. 2, 1889, pp. 11–12.

It would appear from the above that the output of iron ore in France was retrograding; this, however, is only true as regards the scattered deposits of ore in the eastern and central districts, which are unable to compete in cheaper ores on the eastern portion and of the north of Spain. It is, therefore, possible that the active development going on in Meurthe and Moselle district will, in a few years, largely increase the total output of the country.

The chief cause of the large decrease is the consumption of Algerian ore is due to the diminished yield of large mines near Bona. The largest supplies of imported ore are drawn mostly from Bilbao, and in a somewhat lesser degree from Luxembourg.

The best spathic ores in France come from a few districts in the Eastern Pyrennes and Savoy. The former are used by Messrs. Holtzer & Co. in their charcoal blast furnaces at Ria, the pig from which is mostly used for making crucible steel. The oölitic ores are similar in composition to those in Northamptonshire and Lincolnshire in England. One of the best representative series is that of Micheville, near Longwy, where three beds are worked of the following composition:

	Silica.	*Aluminium.*	*Lime.*	*Iron.*	*Phosphorus.*
(1) Top bed (8½ feet thick), . .	13·4	6·70	18·80	27·02	1·16
(2) Middle bed (6½ feet thick,) .	13·23	7·07	7·24	39·80	1·46
(3) Lower bed (4 feet thick), . .	15·85	6·87	4·77	40·80	1·45

The middle bed is found to give the best results in the furnace. About 100,000 tons of these ores are mined annually and smelted with additions of Luxembourg ores.

A remarkable series of deposits of magnetic iron ores, almost totally different from any other in Western Europe, have been recently developed near Cherbourg. These deposits occur in nearly vertical beds and belts from ten to forty-five feet in thickness in the quartzite flanking the coast cliffs, the outcrops of the beds nearest the shore alone being visible at lowest spring tides. The ore runs from fifty-five to sixty per cent. iron, eight to fourteen per cent. silica, and 0·25 to one per cent. phosphoric acid.

THE PIG IRON MANUFACTURE.

According to official statistics, the production in 1882, 1887 and 1888 was as follows:

	1882.	1887.	1888.
North:			
Nord,	255,322	223,315	231,693
Pas-de-Calais,	53,126	97,920	85,391
Totals,	318,448	321,235	317,084
Centre:			
Loire,	58,547	31,536	34,161
Saône-et-Loire,	177,740	55,001	70,107
Allier,	90,507	28,151	18,090
Rhône,	89,437	8,700	14,368
Cher,	17,959	4,590	14,525
Isère,	36,763	13,307	13,945
Totals,	472,953	141,285	165,196
South:			
Gard,	144,818	73,789	54,994
Aveyron,	33,388	6,746	6,465
Ardèche,	103,316	47,214	37,933
Bouches-du-Rhône,	25,739	13,536	21,250
Ariège,	22,150	9,632	7,364
Totals,	329,411	150,917	128,006
East:			
Meuse,	9,767	5,762	3,090
Meurthe-et-Moselle,	716,043	770,842	911,009
Haute-Marne,	82,865	63,148	43,589
Ardennes,	22,258	18,298	20,475
Totals,	830,933	858,050	978,163

The total product of the three years was 2,039,000 metric tons in 1882, 1,306,930 tons in 1887 and 1,688,976 tons in 1888; 60,231, 20,886 and 22,792 tons thereof being pig made with charcoal or a mixture of charcoal and coke as fuel. Of the totals named, 441,318 tons in 1882, 355,892 tons in 1887 and 382,046 tons in 1888 were foundry iron, the balance being mill iron and pig used for conversion into steel. A glance at the figures compiled for the different districts shows how high, relatively, is the position of the east, that section which adjoins and participates in the famous minette ore

fields of Luxembourg. Its percentage rose from 40·7 in 1882 to 65·6 in 1887 and fifty-eight in 1888.*

The production for the first half of 1889 is stated to have been as follows:

Description.	*Forge Pig.* tons.	*Foundry Pig.* tons.
Coke pig,	644,259	201,935
Charcoal pig,	3,643	1,035
Mixed brands,	—	2,955
Totals,	647,902	205,915

The total production thus amounted to 853,817 metric tons, against 821,824 tons in the first half of 1888, the increase being 31,993.†

The following table shows the total production in the various departments for the year 1889‡:

	Forge Pig. tons.	*Foundry Pig.* tons.	*Totals, 1889.* tons.	*Totals, 1888.* tons.
Allier,	23,539	9,655	33,194	26,451
Ardèche,	24,022	5,320	29,342	37,933
Ardennes,	20,770	—	20,770	20,475
Ariège,	3,153	41	3,194	7,364
Aveyron,	11,988	—	11,988	6,467
Bouches-du-Rhône,	14,933	839	15,772	14,414
Charente,	—	—	—	297
Cher,	—	10,351	10,351	14,525
Dordogne,	450	—	450	225
Gard,	44,605	4,366	48,971	53,363
Gironde,	—	—	—	450
Isère,	23,004	44	23,048	13,375
Landes,	50,619	5,712	56,331	50,396
Loire,	32,473	20	32,493	36,376
Loire-Inférieure,	18,543	9,246	27,789	12,883
Lot-et-Garonne,	—	13,590	13,590	14,357
Marne (Haute-),	24,582	33,261	57,843	45,340
Meurthe-et-Moselle,	658,430	282,289	940,719	911,009
Meuse,	3,408	183	3,591	3,090
Nord,	178,306	38,408	216,714	231,803
Pas-de-Calais,	84,315	—	84,315	85,391
Pyrénées-Orientales,	3,095	—	3,095	3,816
Rhône,	8,340	1,780	10,120	12,700
Saône (Haute-),	280	31	311	1,740
Saône-et-Loire,	75,654	—	75,654	70,109
Tarn,	2,235	600	2,835	—
Totals,	1,306,744	415,736	1,722,480	1,683,341

* *Iron Age*, September 5, 1889, p. 371.

† *Bulletin du Comite des Forges*, No. 249, pp. 58–62.

‡ *Iron* (Eng.), March 7, 1890, p. 216.

The production of charcoal pig iron has continuously decreased. In 1887, there were only a few charcoal furnaces in blast, some of them in Southwestern France, making special gray pig for ordnance purposes; two in the Franche-Comté district; one in the Alps (Isère), and one in the Western Pyrenees.

The Brignoud blast furnace (Isère) is smelting alpine spathic ores, and produces the excellent charcoal pigs used in the Bonpertuis Steel Works for the production of steel by charcoal hearth refining.

The Ria blast furnace (Western Pyrenees), belonging to Messrs. J. Holtzer & Co., is producing, with the manganiferous brown hematites and the spathic ores of the country, gray and white manganiferous pigs, used in the Unieux Steel Works for making their celebrated products.

For a number of years it was a peculiar practice with some of the French blast furnace managers to use a mixture of coke and charcoal; the practice, however, appears to be dying out, and at the present time is only in use in a few furnaces in Eastern France.

The following statement shows the changes in blast furnace plants which have taken place during the decade from 1877 to 1887:

IRON FURNACES IN BLAST.*

Districts.	*1877.*	*1887.*
North and Pas-de-Calais district,	16	12
Meurthe and Moselle district,	32	31
Champagne district,	59	14
Franche-Comté district,	9	2
Central district,	21	7
Northwestern district,	13	1
Perigord and Aveyron district,	19	4
Pyrénées and Landes district,	18	11
Loire and Rhône district,	29	10
Alpine district,	6	3
Southeastern district,	10	6
	232	101

* *Journ. Iron and Steel Inst.*, No. 2, 1889, pp. 14–15.

The total number of blast furnaces has decreased more than one-half, but the production of pig iron has nevertheless increased. From about 6,500 tons, the mean annual output per furnace has increased to 15,500 tons, and, if the details were considered, it would be found that the progress in this respect has occurred in the two first districts, and, above all, in the Meurthe and Moselle district, which, with less than one-third part of the total number of the French furnaces, has produced more than one-half of the total annual production of pig iron.

Some of the iron works in the Loire region are using, for the production of superior iron and steel with ordinary pig, a special refining process (Rollet's process). It consists in the melting of the pig with an extra-basic slag, obtained by means of fluorspar and limestone. This melting is effected in a basic-lined or water-jacketed cupola furnace, blown by hot blast. The pig iron is thus purified by the removal of the greater part of its sulphur and of a certain portion of its phosphorus. The refined metal obtained is sometimes cheaper than the pure pig made with manganiferous foreign ores. The Rollet process is not specially exhibited, but its products can be seen among the exhibits of the Holtzer and Firminy Companies.

PRODUCTION OF ROLLED IRON IN FRANCE IN 1882, 1887 AND 1888.

North:	*1882.*	*1887.*	*1888.*
Nord,	335,442	285,631	303,541
Pas-de-Calais,	308	325	430
Totals,	335,750	285,956	303,971
Centre:			
Loire,	84,280	37,361	37,111
Saône-et-Loire,	64,949	68,126	71,564
Allier,	38,378	29,360	31,631
Cher,	570	560	627
Isère,	14,833	5,155	4,009
Nièvre,	20,373	5,049	6,672
Totals,	223,383	145,611	151,614

	1882.	1887.	1888.
South:			
Gard,	27,916	14,870	14,103
Aveyron,	19,986	11,562	10,200
Bouches-du-Rhône,	1,567	880	1,457
Ariège,	16,537	6,361	5,331
Totals,	66,006	33,373	31,091
East:			
Meuse,	20,103	7,993	10,717
Meurthe-et-Moselle,	49,111	42,168	42,368
Haute-Marne,	90,773	61,657	88,718
Ardennes,	79,961	64,290	67,851
Totals,	239,948	176,108	209,654
Total product,	1,073,021	771,610	833,839

The total production of wrought iron, in 1882, was 1,073,021 metric tons, which declined to 771,610 tons in 1887, rising again to 833,839 tons in 1888.

Many changes have taken place in this industry in France since 1878. Prof. Jordan gives the following figures in relation to it and to the manufacture of steel in open fires and puddling furnaces:*

	1877.	1887.
Number of puddling furnaces (iron),	995	637
Number of puddling furnaces (steel),	51	35
Number of open-fires (iron),	243	53
Number of open-fires (steel),	6	5
	tons.	*tons.*
Production of puddled iron,	821,006	617,997
Production of charcoal refined iron,	63,487	16,864
Production of puddled and charcoal refined steel,	20,273	12,532

The practice of puddling iron is gradually decreasing, owing to the increased use of soft steel for structural purposes.

The following are details of the production of "finished iron" in France during 1889.†

* "Notes on the Iron and Steel Manufacture in France, in 1887." *Journ Iron and Steel Inst.*, No. 2, 1889, p. 21.

† *Iron* (Eng.) March 7, 1890, p. 216.

FINISHED IRON.

	Rails. tons.	*Merchant Iron.* tons.	*Plates.* tons.	*Totals 1889.* tons.	*Totals 1888.* tons.
Aisne,	—	—	341	341	371
Allier,	197	19,368	7,888	27,453	31,631
Ardennes,	—	54,496	13,873	68,369	67,851
Ariège,	—	5,664	—	5,664	5,330
Aube,	—	5,091	—	5,091	5,476
Aveyron,	—	14,407	—	14,407	10,207
Bouches-du-Rhône,	—	1,395	—	1,395	1,457
Charente,	—	—	—	—	223
Cher,	—	—	—	—	627
Côte-d'Or,	—	6,324	556	6,880	7,870
Côtes-du-Nord,	—	3,550	—	3,550	3,945
Dordogne,	—	2,990	—	2,990	2,415
Doubs,	—	2,187	2,584	4,771	14,533
Eure,	—	5,100	—	5,100	2,900
Gard,	121	13,213	—	13,334	14,089
Garonne (Haute-),	—	1,378	—	1,378	1,286
Gironde,	—	75	—	75	180
Ile-et-Vilaine,	—	83	—	83	130
Isère,	—	2,682	—	2,682	4,006
Jura,	—	10,579	5,097	15,676	12,358
Landes,	—	6,691	—	6,691	5,053
Loire-et-Cher,	—	31	—	31	43
Loire,	—	28,005	8,719	36,724	36,523
Loire-Inférieure,	—	10,334	1,246	11,580	11,196
Lot-et-Garonne,	—	220	—	220	140
Marne (Haute-),	—	55,105	4,261	59,366	65,777
Meurthe-et-Moselle,	1	33,534	7,200	40,735	42,368
Meuse,	—	8,757	—	8,757	7,022
Nièvre,	231	6,009	70	6,310	6,672
Nord,	—	259,931	50,563	310,494	307,555
Oise,	—	16,354	1,600	17,954	13,027
Orne,	—	250	—	250	200
Pas-de-Calais,	—	521	—	521	430
Pyrénées-Orientales,	—	177	—	177	182
Rhin-Haut (Belfort),	—	160	—	160	170
Rhône,	—	20	—	20	—
Saône (Haute-),	—	11	1,143	1,154	1,075
Saône-et-Loire,	—	57,915	11,626	69,541	71,044
Sarthe,	—	33	—	33	37
Savoie,	—	15	—	15	9
Savoie (Haute-),	—	1,010	854	1,864	1,881
Seine,	—	34,261	—	34,261	53,595
Seine-Inférieure,	—	250	—	250	336

FINISHED IRON.—*Continued.*

	Rails. tons.	*Merchant Iron.* tons.	*Plates.* tons.	*Totals 1889.* tons.	*Totals 1888.* tons.
Seine-et-Oise,	—	2,500	—	2,500	2,572
Somme,	—	2,561	—	2,561	2,061
Tarne,	—	1,816	—	1,816	1,105
Vosges,	—	—	120	120	—
Yonne,	—	14	—	14	15
Totals,	550	675,067	117,741	793,358	816,973

PRODUCTION OF STEEL IN FRANCE IN 1882, 1887 AND 1888.

	1882.	*1887.*	*1888.*
North:			
Nord,	61,853	87,664	95,212
Pas-de-Calias,	—	61,462	50,985
Totals,	61,853	149,126	146,197
Centre:			
Loire,	132,529	54,536	67,613
Saône-et-Loire,	101,320	45,519	48,746
Allier,	23,301	11,527	10,360
Isère,	8,739	4,321	3,859
Nièvre,	5,731	9,897	9,070
Totals,	271,620	125,800	139,653
East:			
Meuse,	51	5,558	6,155
Meurthe-et-Moselle,	1,616	41,265	37,814
Haute-Marne,	—	9,160	16,327
Ardennes,	171	18,218	21,096
Totals,	1,838	74,201	81,392
South:			
Gard,	83,579	40,534	34,722
Aveyron,	25,803	—	—
Ariège,	6,223	4,496	2,087
Totals,	115,605	44,030	36,809
Total product,	458,238	493,294	525,646

PRODUCTION OF STEEL RAILS IN FRANCE.

	1882.	*1887.*	*1888.*
North,	59,529	114,620	94,863
Centre,	170,208	4,747	5,098
South,	106,461	32,145	23,481
East,	—	25,183	21,818
Landes,	—	26,113	30,313
Total product,	336,259	202,909	175,598

PRODUCTION OF STEEL FOR THE FIRST HALF OF 1889, COMPARED WITH THAT OF THE FIRST HALF OF 1888.

Description.	*First Half, 1889.* tons.	*First Half, 1888.* tons.	*Increase or Decrease.* tons.
Rails, Bessemer,	75,412	83,538	— 8,126
Rails, open hearth,	3,549	3,537	+ 12
Total,	75,961	87,075	— 8,114
Merchant steel, Bessemer,	52,529	46,905	+ 5,624
Merchant steel, open hearth,	54,794	41,796	+ 12,998
Merchant steel, puddled,	12,177	13,061	— 884
Merchant steel, cement,	776	686	+ 90
Merchant steel, crucible,	5,493	4,304	+ 1,189
Total,	125,769	106,752	+ 19,017
Plates, Bessemer,	15,192	17,925	— 2,733
Plates, open hearth,	21,820	22,655	— 835
Plates, miscellaneous,	4,346	5,217	— 871
Total,	41,358	45,797	— 4,439
Total steel,	246,088	239,624	+ 6,464

TOTAL PRODUCTION OF STEEL IN THE DIFFERENT DEPARTMENTS OF FRANCE DURING 1889.*

	Rails. tons.	*Bars.* tons.	*Plates.* tons.	*Totals, 1889.* tons.	*Totals, 1888.* tons.
Aisne,	—	—	702	702	644
Allier,	70	9,926	4,102	14,198	10,360
Ardennes,	—	8,691	14,696	23,387	22,038
Ariège,	—	4,566	—	4,566	2,931
Aube,	—	3,048	—	3,048	2,950
Charente,	—	168	—	168	—
Côte-d'Or,	60	2,587	127	2,774	604
Côtes-du-Nord,	—	18	—	18	15
Doubs,	—	7,331	1,435	8,766	1,748
Gard,	18,430	13,817	—	32,247	34,843
Ile-et-Vilaine,	—	9	—	9	—
Isère,	—	5,367	—	5,367	4,751
Jura,	—	12,139	3,360	15,499	5,496
Landes,	22,871	3,920	—	26,791	34,378
Loire,	2,093	50,457	12,178	64,728	68,490
Loire-Inférieure,	—	4,852	6,578	11,430	7,775
Marne (Haute-),	—	13,911	721	14,632	14,637
Meurthe-et-Moselle,	28,132	13,829	2,242	44,703	37,873

* *Iron* (Eng.), March 7, 1890, p. 216.

TOTAL PRODUCTION OF STEEL IN THE DIFFERENT DEPARTMENTS OF FRANCE DURING 1889.—*Continued.*

	Rails, tons.	*Bars, tons.*	*Plates, tons.*	*Totals, 1889, tons.*	*Totals, 1888, tons.*
Meuse,	—	8,819	—	8,819	7,150
Morbihan,	—	—	11,950	11,950	10,000
Nièvre,	178	8,443	767	9,388	11,112
Nord,	25,202	33,919	8,109	67,230	84,988
Oise,	—	16,825	1,108	17,993	13,053
Pas-de-Calais,	42,717	7,804	—	50,521	51,002
Rhin-Haut (Belfort),	—	3,224	—	—	2,830
Rhône,	—	275	—	275	364
Saône (Haute-),	—	—	30	30	—
Saône-et-Loire,	5,594	24,030	18,338	47,962	48,911
Savoie,	—	80	—	80	81
Seine,	—	2,942	—	2,94	2,176
Seine-Inférieure,	—	4	—	4	—
Tarn,	—	1,940	—	1,940	1,934
Vosges,	—	—	1,680	1,680	1,660
Works not enumerated,	—	32,000	—	32,000	32,500
Totals,	145,347	294,951	88,723	529,021	517,294

MANUFACTURE OF STEEL IN CONVERTERS.

Prof. Jordan states that, according to official statistics, there were twenty-four Bessemer converters at work in France during the year 1877, but no data is given of their output. In 1887, twenty-eight were in operation. The output of acid Bessemer and of basic steel is not indicated for that year, but Prof. Jordan estimates the production of basic steel at 143,000 tons. Prof. Jordan remarks that "the producing power of basic steel in the French steel works is, however, much greater than would be supposed from these figures, as well as of acid Bessemer steel. Indeed, although the official statistics indicate that some twenty-eight converters were at work in 1887, this only represents about two-thirds of the actually existing converters, which will number from forty-two to forty-four. Some Bessemer steel works have been entirely idle in 1887, such as those of Terrenoire, Givors, Saint Nazaire, Pagny on the Meuse, while some others worked with only a part of their plant.

The Bessemer steel manufacture was first introduced in

France in Messrs. Jackson & Co.'s works at Saint-Seurin-on-l'Isle, near Bordeaux, and afterwards in Messrs. Petin, Gaudet & Co.'s works at Assailly (Loire). It was afterwards developed in various districts, especially in the Centre, at the Imphy and Montluçon Works; in the Loire district, at the Terrenoire, Creusot, Saint Etienne, and Givors Works; and in the Gard district, at the Besseges Iron Works. The pig iron used by these works was made with mixtures of local ores and ores imported from Algiers and Spain, these last being somewhat dear, owing to the sea and railway freights. Hence, the new steel works, established during the last ten or twelve years, have been located in the closer neighborhood of seaports, such as the Denain Steel Works (the first built), the Isbergues, Saint Nazaire, Boucau, and Beaucaire Steel Works, the first four being intended for using Spanish and the last for Algerian ores.

The Isbergues Steel Works (Pas-de-Calais), belonging to the Acieries of France Company, are provided with two eight-ton American type converters and are supplied with pig iron from two large blast furnaces. They announce their annual steel-producing power as 100,000 tons. These works exhibit their raw materials and their steels, classed in five categories, according to their hardness and mechanical properties. They have hitherto produced all kinds of steel rails, steel girders, blooms and billets.

The Adour forges or Boucau Steel Works, near Bayonne, belonging to the "Acieries de la Marine et des Chemins de Fer" Company, having two converters, also exhibit a ground-plan of their works, their raw materials and their products, accompanied by interesting analyses. They produce cast steel, distributed into fifteen numbers or classes, from the hardest to the softest. These works have also Siemens-Martin furnaces. They were established in 1883, specially for making steel rails, but since that time they have been obliged to look for other markets.

It is the same with the Denain Steel Works, which exhibit only their products in the special annex of the northern forges, and which possess also open-hearth furnaces.

The manufacture of basic Bessemer steel, or so-called Thomas-Gilchrist steel, is effected in the four following works:

Jœuf	Steel Works,	6	converters,	of together	64	tons capacity.
Longwy	"	3	"	"	45	"
Valenciennes	"	2	"	"	20	"
Creusot	"	2	"	"	20	"

Adding the works in course of erection, Pagny-on-the-Meuse Steel Works, two converters, of together twenty tons capacity, the sum total is fifteen converters with an aggregate capacity of 169 tons, equal to about 500,000 tons of steel annually.

The three first steel works are specially converting Meurthe and Moselle pigs obtained from the local oölitic ores; the fourth (Creusot) converts pig iron made with its own oölitic Mazenay ores.

The Jœuf Works (Messrs. de Wendel) have not exhibited anything; the Creusot Works (Messrs. Schneider & Co.) have only exhibited their phosphoric mineral manures in the Agricultural Section.

The Longwy Steel Works make 250 to 300 tons of basic steel per day with their own pig (of which the composition is given above). They produce especially soft, very soft, and extra soft steels (Nos. 6, 7, 8 of the Longwy hardness scale), and also particularly extra soft steels (No. 9) for making wire, nails, etc. The breaking-stress for this last-named steel is less than 5,000 pounds per square inch, and the elongation is more than twenty-eight per cent. Its composition is given as follows:

	Per Cent.
Carbon,	0·08
Manganese,	0·25 to 0·30
Sulphur,	spur.
Phosphorus,	0·03 to 0·05

These works are delivering to the trade blooms, billets, bars of every description, plates and rails, as also wire rods.

The North and East Steel Works, at Valenciennes, are also using basic pigs of the Meurthe and Moselle district, mixed sometimes with extra-phosphorous pigs, imported from Germany or from the North of England. They give the

possible output of their two converters as 80,000 to 100,000 tons of basic steel annually. They sell rails, girders, bars, billets and blooms, and their exhibits can be seen in the North of France special annex.

The Stenay Iron and Steel Works, in the Meuse Department, are about the only works in France working their process. They decarbonize pig iron so as to obtain rolled or cast products into small (one ton or about) converters, according to the Robert Patented Process.* Their exhibit includes numerous specimens of the products." †

MANUFACTURE OF STEEL IN OPEN-HEARTH FURNACES.

According to Prof. Jordan's statements there were in 1877 fifty-one open-hearth furnaces in France. Their number appears to have decreased in 1887, owing to the closing of the Sireuil Works, in which Messrs. Martin were the pioneers of this new manufacture. The official statistics furnish the following data for 1887:

Number of open-hearth furnaces in work,	69
	tons.
Output in 1887,	143,764
viz: Rails,	13,709
Bars,	90,498
Plates and sheets,	39,557

But the number of furnaces in working order in 1889 is notably greater, and may be estimated at about seventy-five furnaces of various systems and sizes.

Since the time of the introduction by Messrs. Martin of the new process in their Sireuil Works, the size of the open-hearth furnace has always been increasing. Instead of the three to four-ton furnaces first used, ten-ton furnaces, twenty-ton furnaces, and even, as in some steel works of the Loire district, thirty-five ton furnaces can now be found.

In reference to the manner of constructing the furnace, the majority are of the fixed type, the so-called Siemens-Martin furnace, designed at first by the Messrs. Martin themselves, and having regenerators situated underneath the

* The Robert process will be specifically treated further on.

† *Journ. Iron and Steel Inst.*, No. 2, 1887, pp. 24–25.

hearth, and the reversing valves on one of the small sides. In two or three steel works only can the Pernot furnaces be found, with a revolving circular basin or hollow hearth, or the Batho furnace, with a round hearth, supported by an iron plate, free underneath, and with round regenerators with plate-iron casing placed laterally and above ground.

The mode of working is usually the "*scrap process*." What is known as the "*ore process*" does not appear to be used in France. The continued use of scrap and ore known as the "Landore process," is used only at the Alleyard Works. Prof. Jordan states that the nature of the lining varies in the different works, and according to the description of materials used. Sometimes the lining is *acid*; that is, it is made with sand, gannister, or silicious puddle; sometimes it is *basic*—that is, made with magnesia bricks or puddle (according to the system patented in 1869 by Mr. Emile Muller), or with dolomitic bricks and blocks; at other times the lining is *neutral;* that is, made with chrome ore (according to the Valton-Remaury process). When the lining is made with chrome ore, Messrs. Valton and Remaury state that no material is taken from the lining either by the molten metal or by the slag, so that no corrosion takes place, and it becomes possible to act on the metal either by scraps or by ores, or by various agents in such a manner as to effect a complete dephosphorization, and to produce various descriptions of steel. Messrs. Valton and Remaury exhibit drawings of furnaces neutrally lined, specimens of their chrome ore and linings, and products of some steel works working their process.

French steel works, such as Fourchambault and Alais, for instance, choose the neutral lining rather than the basic one, which, they say, is sooner worn out, and above all when some iron ore is used in the process.

The properly-called dephosphorizing mode of working; that is, the conversion of truly phosphoretic pigs (such as those of Meurthe and Moselle) in cast steel by the open-hearth process, is not yet much used in France. This description of pig iron is sooner dephosphorized in the basic Bessemer converter. M. Fould-Dupont, however, shows in his beautiful

exhibit (Central Gallery) cast steel of every form obtained in open-hearth furnaces from his Pompey pig iron.

On the other hand, in many steel works, the basic or neutral lining is used for making open-hearth steel with ordinary pig and scrap, not free enough from phosphorus to yield good steel on an acid lining, and too low in phosphorus to be worked in the basic converter. Some of them are even working pure pig and scrap upon basic and neutral hearths, and produce soft and extra soft steels of very high quality; these steels being, besides, either simply carbon steels, or steels into whose composition enter silicon, manganese, and chrome, inasmuch as the open-hearth furnace is a very convenient and adaptable one, which allows the easy introduction and stirring of any reagent in the metallic bath.

[*To be continued.*]

MEMOIR OF FREDERIC GRAFF.

FREDERIC GRAFF, Civil Engineer, whose sudden death upon the 30th of March, 1890, his fellow-members have to mourn, was the son of Frederic Graff and Judith Swyer, his wife, and was born in Philadelphia, March 21, 1817.

His great-grandfather, Jacob Graff, came to this country from Hildesheim, Germany, in 1741, and established a brick-yard in Philadelphia, where he conducted a large business. His son, Jacob Graff, Jr., was a builder, and owned the house in Market Street, above Seventh, where Mr. Jefferson wrote the Declaration of Independence.

Jacob Graff, Jr., left two sons, Charles and Frederic, who were well known to many of us. Frederic, Sr., was born in 1774, in the house above-mentioned. In 1779, he was engaged as draughtsman and assisting engineer in erecting the city water works, in Centre Square, of which he was appointed Superintendent, in 1805, continuing in that position as long as they were used. These works were begun in May, 1799. They were started January 1, 1801, and were used until September 5, 1815, and were finally taken down in 1827.

The water was pumped by steam-power from near Chestnut Street wharf, Schuylkill, into a reservoir, and thence distributed through wooden mains. One of the peculiarities of the works was that the steam boiler was made of wooden planks, and was heated internally by iron flues. A portion of the boiler is in the curiosity shop of the FRANKLIN INSTITUTE.

In 1810, a Committee of Councils directed Frederic Graff and John Davis to make examinations and a report on a better water supply. They selected Mount Morris, originally called Fairmount, for the site of a new reservoir with a pumping station on the river side, at the base of the hill. The steam plant and pumps were begun in 1812. The water-power plant and new reservoir were begun in April, 1819, and completed October 25, 1822.

The whole establishment, together with the necessary connections, iron mains, stop-cocks, fire-plugs, etc., was designed and constructed by, or under the direction of, Frederic Graff, Sr., of whom the Fairmount Water Works remains "a livelong monument."

The fame of these works caused him to be consulted upon the establishment of water works throughout the United States.

He was one of the earliest members of the FRANKLIN INSTITUTE, elected in 1826.

Feeling that his own life had been filled with much care and anxiety, attended with little profit, he resolved that his son should not follow his own profession. He, therefore, placed him, when his education had been completed, with a large hardware house to learn the business. The young man, however, did not take kindly to mercantile pursuits, so that, after a fair trial, the head of the house told his father that his son would never make a merchant, that his talent was evidently inventive and mechanical, and that his whole amusement during hours of leisure was in making things of wood and strings, "and the funny part is, that everything he makes goes."

So the father yielded, and young Frederic studied engineering.

On April 6, 1842, he became Assistant Engineer of the Water Department, under his father, until April 21, 1847, when, upon the death of the latter, he was elected his successor as Chief Engineer. In this position he remained until July 5, 1856, when he resigned.

Upon March 1, 1866, he was again elected Chief Engineer and accepted the place upon the earnest solicitation of his friends. He remained in office until February 28, 1872, when he declined a re-election. During this term he was a Commissioner of Fairmount Park.

In 1883, he was again named for the position, but notwithstanding the repeated urgencies of his friends he stood firm in his resolution to decline.

The fact is that he had no sympathy with what are called political methods.

As Chief Engineer he was a public officer charged to conduct the works with a single eye to the good of the Department, so that he was often obliged to run contrary to the wishes of the party. Consequently his position was one of continual warfare entirely foreign to his nature.

During Mr. Graff's first term as Chief Engineer, 1847 to 1850, the following new works were designed and executed:

In 1850. Built Corinthian Avenue reservoir with mains connecting with Fairmount.

In 1851. Repaired Fairmount dam and extended wheelhouse, and introduced the first turbine wheels.

In 1851. Made first communication with Councils, with regard to establishing a park on the east side of the Schuylkill, with plans, map and description. This led to the purchase and improvement of Lemon Hill and the Eaglesfield property. It was the nucleus of Fairmount Park of to-day.

In 1854, after consolidation, reorganized the whole Department anew, combining the city works with those of the districts of Spring Garden, Northern Liberties and Kensington.

During Mr. Graff's second term as Chief Engineer, 1866 to 1872, the following new works were designed or executed:

1867 to 1872. Rebuilt Fairmount dam and enlarged pump-houses.

1870. Built Belmont reservoir at George's Hill, with steam works at Belmont and connections. Also, the submerged main across the Schuylkill to supply high grounds on the east side. Started in 1870.

1871 to 1872. Designed the large reservoirs in the East Park. Work commenced and banks raised to average three feet high.

The above-mentioned work was performed in his capacity as Chief Engineer of the Water Department.

1863. Designed and built the unique pipe bridge across the Wissahickon, the water-pipe being used for the compression chord.

1876. Built water works to supply the Centennial Exhibition.

1882 to 1883. Served on Board of Experts with Messrs. Merrick and Chesborough, on city water supply.

1886. Mr. Graff was appointed one of a commission of three expert engineers for the investigation of the affairs of the Washington Aqueduct tunnel, reservoir, etc., lately constructed, and entered upon that duty up on the 29th of October, the service occupying three months. His colleagues were Col. Henry Flad and Mr. Joseph M. Wilson, who speak warmly of the energy, activity and thoroughness which Mr. Graff displayed in the work.

Mr. Graff was frequently consulted from other cities, and among other matters he was employed to make trial of pumping engines and hydraulic works at various places: Cambridge, Mass.; Hartford, Conn.; Providence, R. I.; Brooklyn, N. Y., and others.

In 1860, he was employed as manager of the Port Richmond Iron Foundry, in this city, with the expectation of being associated as a partner; but upon the different reorganization of the firm, three years later, he withdrew. After his second term as Chief Engineer of the Water Department, he was engaged with Henry H. Worthington, from 1873 to 1877.

Besides these professional employments, Mr. Graff found time to give valuable services to numerous institutions in Philadelphia for the promotion of charitable, scientific, edu-

cational and industrial uses, or of the fine arts, in various branches, as the following list will testify:

1839. He was elected member of the FRANKLIN INSTITUTE, and became a life member in 1855. He was a Manager in 1852, 1854, 1858, 1865, 1880; Vice-President, 1882 to the end. He served on the Committee on Exhibitions, and was Chairman of the Sub-Committee on Buildings and Machinery at both of the Exhibitions of 1874 and 1884. On both occasions he rendered signal services. In 1884, he gave up his whole summer to the work.

Col. Banes, Chairman of the Committee on Exhibitions in 1884, desires that the present Committee should put on record and emphasize his testimony to Mr. Graff's services and sacrifices upon that occasion, and the Chairman of the same Committee in 1874 is glad to record a like tribute to his services then, both on his own Sub-Committee and also on the Sub-Committee on Space.

1853. He was elected a member of the Academy of Natural Sciences, and was Trustee of the Building Fund.

1854. He was elected a Director of the American Academy of Music, and continued so for thirty years. He served efficiently on the Building Committee.

1855. He was elected a Director of the Musical Fund Society.

1856. He was elected a member of the Historical Society.

1862. One of the founders of the Photographic Society. He was Vice-President from 1862 to 1866, and also 1885. He was President from 1867, 1868, 1869–1886, 1887 and 1890.

1863. Became a member of the Union League thirteen days after organization.

1868. Elected a member of the American Philosophical Society.

1873. Elected a member of the American Society of Civil Engineers; a Director in 1884, and President in 1885–86.

1879. A contributor to the Pennsylvania Museum and School of Industrial Art. Elected a Trustee in January, 1879, and Chairman of the Committee on Instruction. Vice-President from and after 1882. A letter from one of his co-trustees bears warm testimony to the earnest zeal

and efficiency with which Mr. Graff served this association upon all occasions.

1880. He was elected to the Engineers' Club, and became President in 1880.

1882. He was one of the founders of the Zoölogical Society and Gardens; one of the Managers upon organization, and President in 1882 and afterwards.

1887. Became a Director of the Pennsylvania Institute for the Deaf and Dumb.

The significance of this list lies chiefly in the fact that Mr. Graff never sought promotion, but, on the contrary, tried to avoid it. His prominence was always honorable, because it was always thrust upon him. His gentleness in manner and vigor in action, his integrity, experience and clear judgment, were well known, and his associates always desired to have the benefit of them. When they had succeeded in persuading him to take the laboring oar, they were confident that the work would be well done, and they were not disappointed. He was urged time and again to permit his name to be presented as candidate for President of this INSTITUTE, but always declined. His reasons are now more apparent than they were at the time.

Mr. Graff was a man of marked scientific ability and good judgment. He was noted for his quick perception and ready application of the knowledge he acquired.

Few men with his opportunities would have done so well as he, for his early engineering education was probably rather special.

He was always willing to impart his knowledge to others, when he saw that it was needed, and gave it in a clear and convincing manner. He had an evenly-balanced mind, with very considerable inventive faculty, which was applied to his engineering practice as occasion required.

He took great delight in the fine arts, architecture, music, painting, drawing and carving. He was always glad to give his professional aid to poor parishes in the erection of their church buildings. He had remarkable manual dexterity. His drawings are models of neatness and clearness. What is not so well known, his skill in carving in wood or stone would alone have made him eminent.

Some of his scarf-pin heads, carved with a penknife out of common marbles, would rival the finest cameos in lava.

Mr. Graff twice visited Europe; first in company with his cousin, and afterwards, in 1878, with his wife. The journey extended from Norway to Spain. A third visit was projected for this year, the passage was taken and preparations were making when he was summoned alone to the far journey.

Mr. Graff married Elizabeth Mathieu (who survives him), youngest daughter of Capt. John E. Mathieu, of Philadelphia. He left no children.

He was happy in his domestic relations, and an earnest Christian in faith and practice, and a devoted member of the Protestant Episcopal Church.

He had been aware for many years of the condition of his heart and liability to sudden death. While this did not disturb his cheerfulness, it led him to avoid excitements. He was very agreeable socially, a kind and constant friend, a useful citizen, and exemplary in every relation of life.

MEMOIR OF MAJOR OTHO E. MICHAELIS, PH.D., U.S.A.

The death of this able and accomplished officer will be felt in many quarters outside of the United States Army, of which he was a fine representative. Major Michaelis was born in Germany and came to this country in early youth. He was appointed from New York and made Second Lieutenant of the Signal Corps, on September 30, 1863, which office he accepted, October 15, 1863. He was appointed Second Lieutenant of the Ordnance Corps, November 24, 1863, and raised to First Lieutenant, September 12, 1864; Brevet Captain, March 13, 1865; Captain, January 23, 1874. He was Assistant at the Watervliet Arsenal, from 1864 to 1868. On temporary duty at the Detroit Arsenal, 1868 and 1869. Assistant at the Watervliet Arsenal again, from 1869 to 1873. Assistant at the Alleghany Arsenal, from 1873 to 1875. Chief Ordnance Officer, Department of Colorado, 1875

to 1876. Chief Ordnance Officer in the Department of Dakota, from 1876 to 1880. Assistant at the Frankford Arsenal, from 1880 to 1883. And later he has been stationed at the Kennebec Arsenal, Augusta, Me., where the rank of Major was bestowed upon him, and where he died.

This brief record of his services, taken from the Army Register, gives no idea of the man. With a naturally acute and observant mind he united a philosophical faculty which is rare even among those who devote themselves to the mathematical sciences. It was his delight to attack problems both in and out of his profession, and to solve them—which he usually did. Many of the improvements in the machines and in the Ordnance Department, and some important modifications of the famous testing machine in the Watervliet Arsenal are due to his intelligence and sharp observation. It is doubtful if there was another officer in the Army more thoroughly equipped with a mind to take advantage of, and a diligence to secure a complete record of all that is transpiring around him in the field of research. He neglected no opportunity of learning, and shirked no labor in elaborating the details of all that bore on this favorite arm of the service. His loss to the Ordnance Department is one difficult to supply.

In the FRANKLIN INSTITUTE, he made himself known by a number of fugitive papers and by his lecture on the army of Kukuanaland, in vol. cxxviii, p. 258, FRANKLIN INSTITUTE JOURNAL, a humorous plea for improvements in our own army service.

Major Michaelis was an excellent conversationalist in any gathering, full of anecdote, possessing an imperturbable good humor and the tact to make himself popular. He was fond of all manly sports, and an adept at chess and whist; in fact, he had a national reputation at the first of these games, and even in his early "teens" he contested two games manfully with the great Paul Morphy, taking the odds of a rook, which were thought worthy of a place in the commemorative volume of Lange, in which most of the master's games which have been preserved are published. Later, in 1883, he played a noteworthy game with the

greatest of modern masters, Steinitz, which resulted in a draw.

He had the misfortune to lose one of his children by drowning, under very distressing circumstances, a few months ago, and, although his own courage and promptness saved another child from the same fate, he received a shock from which he never fully recovered, and which, it is believed, was the ultimate cause of his death. He was in the city on May 5th and 6th, during the celebration of the first quarter century of the founding of the Military Order of the Loyal Legion, and appeared to be in ordinarily good health as he was warmly greeted by his old friends, but a few days later they were shocked to hear, through the newspapers, of his sudden and unexpected death.

F.

PROCEEDINGS

OF THE

CHEMICAL SECTION,

OF THE

FRANKLIN INSTITUTE.

[*Stated Meeting, held at the* INSTITUTE, *Tuesday, May 20, 1890.*]

HALL OF THE FRANKLIN INSTITUTE.

PHILADELPHIA, May 20, 1890.

Mr. T. C. Palmer, President, in the Chair.

Members present—Dr. L. B. Hall, Prof. E. F. Smith, Dr. Wm. H. Wahl, Dr. H. W. Jayne, Mr. L. J. Matos, Mr. L. E. Williams, Mr. W. L. Rowland, Prof. Henry Trimble, Mr. Reuben Haines, Mr. W. H. Bower, Prof. R. L. Chase, Dr. S. C. Hooker, Mr. Hugh A. Galt, Mr. A. T. Eastwick, Mr. Fred. E. Ives, Mr. A. A. Moore and four visitors.

Mr. A. A. Moore, Franklin Sugar Refinery, Philadelphia, was elected an associate member of the Section.

Dr. Wahl read an interesting and valuable paper on "The Electro-deposition of Platinum."

The author prefaced this paper by the statement that at the next meeting he would exhibit specimens of substances employed in his investigation, and also illustrate the practical working of the processes described. The paper was referred for publication in the JOURNAL of the INSTITUTE.

Dr. Hooker presented a paper on "Derivatives of Lapachic Acid," and exhibited some beautiful specimens of these derivatives. The communication was referred for publication in the *American Chemical Journal*.

Adjourned.

WM. C. DAY,
Secretary.

GIFTS TO THE LIBRARY OF THE FRANKLIN INSTITUTE.

Academy of Natural Sciences. Historical and Descriptive Sketch. From the Academy.

Agricultural Experiment Station, Auburn, Ala. Bulletin Nos. 14 and 15. From the Station.

Alabama Agricultural Experiment Station. Bulletin Nos. 11 to 13. From the Station.

American Chemical Journal. Index Vols. 1 to 10. From the Editor.

American Institute of Mining Engineers:

Keep. Phosphorus in Cast Iron.

Smith, O. Aluminium in Search of a Nickname.

Smith, O. Aluminium in the Drawing-Press.

Fackenthal. Filling and Blowing-In at the Durham Blast Furnace.

Norris. Note on the Friction of Mine-Car Wheels.

Pocock. Electricity and Haulage.

Wittman. Peculiar Working of a Blast Furnace.

Emmons. Notes on the Gold Deposits of Montgomery County, Md.

Cowles. Aluminium Bronze and Brass as Suitable Materials for Propellers.

Cowles. Physical Properties of Some of the Alloys of Manganese, Copper and Aluminium.

Proceedings of the Fifty-Sixth (Twentieth Annual) Meeting, Washington, D. C. February, 1890.

Pearce. The Association of Gold with Other Metals in the West.

Smith, F. C. A Proposed Method for Working Tellurides.

Clark. Some Tests of the Relative Strength of Nitro-Glycerine and Other Explosives.

Blake. Note on the Use of Aluminium in the Construction of Instruments of Precision.

Blake. Wurtzilite from the Uintah Mountains, Utah.

Blake. Uintaite, Albertite, Grahamite and Asphaltum, Described and Compared, with Observations on Bitumen and its Compounds.

Macfarlane. Notes on American Cannel Coal.

Chance. The Rush Creek, Ark., Zinc District.

Goodale. The Occurrence and Treatment of the Argentiferous Manganese Ores of Tombstone District, Arizona.

Hunt. Langley. Hall. The Properties of Aluminium, with Some Information Relating to the Metal.

Fernow. Avalanches.

Goetz. Discussion. Notes on Fuel Gas. From the Institute.

American Copyright League. Eight Pamphlets Relating to Copyright. From the League.

American Economic Association Publications. Vols. 1 to 5. Constitution. From Henry N. Rittenhouse.

American Iron and Steel Association. Annual Statistical Report for 1889. From the Association.

American Statistical Association Publications. New Series 1. From Henry N. Rittenhouse.

American Water Works Association. Proceedings Ninth Annual Meeting. From the President.

Annuaire Scientifique Deherain. 1862 and 1864. From R. A. Fisher.

Atlanta Board of Water Commissioners. Fifteenth Annual Report. Rates and Rules. From the Board.

Atlanta, Ga., Eleventh Annual Report of the Board of Health. From the Board.

Australasian Association for the Advancement of Science. Report of the First Meeting. From the Association.

Baker, Balch & Co. Map of the Country Adjacent to Puget Sound. From the Publishers.

Baltimore Health Department. Annual Report for 1889. From the Department.

Berthollet, C. L. Essai de Statique Chimique. From R. A. Fisher.

Blair Camera Company. Hawkeye Booklet. From the Company.

Board of City Trusts, Philadelphia. Twentieth Annual Report. From the Superintendent.

Board of Health. Reading. Report for 1889. From the Board.

Board of Supervising Inspectors of Steam Vessels. Proceedings of the Thirty-Eighth Annual Meeting. Part 1. From the Board.

Bore, Henry. Story of Steel Pens. From Ivison, Blakeman & Co.

Boston Public Library. Thirty-Eighth Report of the Trustees. From the Librarian.

British Patent-Office. Specifications of Inventions. 1888 and 1889. From the Office.

Buckeye Portland Cement Company. Description of Buckeye Portland Cement. From the Company.

Buffalo City Water Works. Twenty-First Annual Report. From the Water Commissioners.

Builders' Exchange, Official Journal of the National Association of Builders. Vol. 1. Nos. 1 to 9. From John J. Weaver.

California State Mineralogist. Ninth Annual Report. 1889. From the Mineralogist.

Canada Central Experiment Farm. Bulletin No. 2 to 6. From the Director.

Canada Experimental Farms. Reports for 1887 and 1888. From the Director Central Experimental Farm

Canadian Society of Civil Engineers Transactions. Vol 3. Part 2.
From the Society.

Chicago Historical Society. Collections. Vol. 4. Quarterly meeting, April, 1890. From the Society.

Chubb, Thos. H. Retail Catalogue of Fishing Rods for 1890.
From Thomas H. Chubb.

College of Physicians of Philadelphia. Transactions. Vol. 11.
From the College.

Colorado State School of Mines. Annual Report for 1889.
From the President.

Connecticut Agricultural Experiment Station. Annual Report for 1889.
From the Station.

Crandall Typewriter. Descriptive Pamphlets.
From the Crandall Typewriter Company.

Daguin, P. A, Traité de Physique. From R. A. Fisher.

Delaware College Agricultural Experiment Station. Second Annual Report. 1889. From the Station.

Devonshire, E. Water Purification by Means of Iron. From the Author.

Dick, Kerr & Co. Catalogue. From the Company.

Dunkirk Evening Observer. March 27, 1890.
From Henry Raymond Rogers.

Eimer & Amend. Catalogue. From the Firm.

Elisha Mitchell Scientific Society Journal. 1889. Part 2. From the Society.

Engineer Department, U. S. A. Annual Report of the Chief of Engineers, 1889. Parts 1 to 4. From the Chief.

Engineers' Society of Pennsylvania. Proceedings. March 18, 1890.
From the Society.

Engineers' Society of Western Pennsylvania Meeting, February 18, 1890.
From the Society.

Eyerman, John. Bibliography of North American Palæontology for the Year 1889. From the Author.

Fall River, Mass. Twelfth Annual Report of the Board of Health.
From the Board.

Franklin Reformatory Home. Eighteenth Annual Report.
From the Superintendent.

Friends' Free Library and Reading-Room, Germantown. Report.
From the Librarian.

Gay-Lussac. Cours de Chimie. From R. A. Fisher.

Geological Survey of Missouri. Bulletin. No. 1.
From the State Geologist.

Germanischer Lloyd. Internationales Register. I. Nachtrag. 1890.
From L. Westergaard & Co.

Gmelin, J. F. Geschichte der Chemie. From R. A. Fisher.

Grand Lodge of Pennsylvania, F. and A. M. Abstract of Proceedings. 1889. From Spencer Fullerton.

Harris, William A. Technological Dictionary of Insurance Chemistry.
From the Author.

Haüy L'Abbé. Traité de Physique. From R. A. Fisher.

Hart, W. Fairburn. Trade-Marks—Their Object, Use and Protection. From the Author.

Hartford, Conn. Board of Health. Fifth Annual Report. From the Board.

Hartford. Board of Water Commissioners. Thirty-sixth Annual Report for 1889. From the Board.

Henry, James. Æneidea. Vol. 3. Parts 1, 2, 3. Vol. 4. From the Trustees of the Author.

Hensoldt, H. Zwei Jahre in Ceylon. From the Author.

Herbertz's Schmelzofen mit Dampfstrahl. From F. L. Garrison.

Horton, Gilmore McWilliams & Co. New Horton Safety Bicycle. Description. From the Company.

Iron and Steel Institute. Journal. 1889. No. 2. From the Institute.

Interstate Commerce Commission. Third Annual Report. From Hon. Augustus Schoonmaker.

Institution of Civil Engineers. Ireland. Transactions. Vol. 19. From the Institution.

Institution of Civil Engineers. Minutes of Proceedings. Vol. 99. From the Institution.

Jewish Hospital Association. Twenty-fifth Annual Report. From the Association.

Kansas. Board of Railroad Commissioners. Seventh Annual Report for 1889. From the Commissioners.

Kansas State Board of Agriculture. Proceedings. Nineteenth Annual Meeting. 1889. From the Board.

Kansas State Board of Agriculture. Quarterly Report. March, 1890. From the Board.

Kendrick's American Carpet and Upholstery Directory. 1890. From Trades Publishing Company.

Klauber, E. Album of Louisville, Ky., after the Cyclone. From the Author.

K. K. Geographische Gesellschaft. Mittheilungen. 1889. From the Society.

K. K. Geologische Reichsanstalt. Abhandlungen. Band 13. Heft 1. Band 15. Heft 1.
Jahrbuch. Band 39. Heft 3 und 4. From the Institute.

Lacroix and Bezont. Elementary Treatise on Plane and Spherical Trigonometry. From Dr. Isaac Norris, Jr.

Literary and Philosophical Society. Proceedings. Vols. 41 to 43. From the Society.

London and Northwestern Railways. Time Tables. From S. H. Needles.

Manchester Steam Users' Association. Boiler Explosions. Act. 1882. Reports of the Board of Trade. From the Association.

Manchester Steam Users' Association. Report of Proceedings. Annual Meeting. 1889. From the Association.

Mangin, M. Arthur. Voyage Scientifique autour de ma Chambre.
From R. A. Fisher.

Maritime Ship Canal of Nicaragua. Description.
From the Maritime Canal Company.

Masonic Home of Pennsylvania. Fifth Annual Report.
From Spencer Fullerton.

Massachusetts Agricultural Experiment Station. Bulletin No. 36.
From the Station.

Massachusetts Board of Education. Fifty-third Annual Report.
From the Board.

Massachusetts Board of Gas and Electric Light Commissioners. Fifth Annual Report. From the Board.

Massachusetts Board of Railroad Commissioners. Twenty-first Annual Report. From the Board.

Massachusetts. Manual for the General Court. 1890.
From the Secretary of State.

Mechanics' Institute, San Francisco. Report of the Twenty-fourth Industrial Exposition. From the Institute.

Mercantile Library Company, Philadelphia. Sixty-seventh Annual Report.
From the Company.

Meteorological Office, London. Report of the Meteorological Council to the Royal Society for the year ending 31st of March, 1889.
From the Office.

Michigan Mines and Mineral Statistics. 1888. From the Governor.

Michigan State Board of Health. Proceedings and Addresses at Sanitary Conventions. 1889. From the Board.

Miller, J. Bleecker. Trade Organizations. From the Author.

Mills, Charles K. Lesions of the Cauda Equina. From the Author.

National Association of Builders. Official Report. First to Fourth Conventions. From John J. Weaver.

New Bedford Water Board. Twentieth Annual Report.
From the Board.

New Hampshire:
Journal of Senate and House of Representatives. 1889.
Journal of the Constitutional Convention. Laws. 1889.
Massachusetts and New Hampshire. Boundary Commission Reports. 1887 and 1889.
Reports for 1889. From the Secretary of State.

Newark, N. J. Board of Health. Fourth and Fifth Annual Reports.
From the Board.

New Jersey Agricultural College Experiment Station. Bulletin 65 and 66.
From the Station.

New Jersey Agricultural College Experiment Station. Bulletin No. 67.
From the Station.

New Jersey State Librarian. Annual Report for 1889.
From the Librarian.

New Orleans Water Works Company. Twelfth Annual Report.
From the Company.

New York Academy of Sciences:
Annals. Vol. 5. Nos. 1, 2, 3.
Transactions. Vol. 9. Nos. 1 and 2. From the Academy.

New York Meteorological Observatory. Report for 1890.
From the Director.

New York State Museum of Natural History. Bulletin No. 7.
From the State Geologist.

Norfolk and Western Railroad Company. Ninth Annual Report.
From the Company.

Ohio Agricultural Experiment Station. Bulletin No. 2. Vol. 3.
From the Station.

Ohio Agricultural Experiment Station. Bulletin No. 8.
From the Station.

Ohio State Tramway Association. Eighth Annual Meeting.
From the President.

Pelouze and Fremy. Abrége de Chimie. From R. A. Fisher.

Pencoyd Iron Works. Book of Shapes, Tables, etc.
From A. & P. Roberts & Co.

Pennsylvania Academy of Fine Arts. Eighty-first to Eighty-third Annual Report. From the Academy.

Philadelphia City Controller. Thirty-sixth Annual Report.
From the Controller.

Philadelphia City Institute. Thirty-eighth Annual Report.
From the Institute.

Pennsylvania State College Agricultural Experiment Station. Bulletin No. 10. From the Station.

Pennsylvania State Reports, Legislative and Executive Documents, Handbooks, etc. From the Librarian of the Senate.

Pneumatic Railway Company. Announcement. From Basil Sewall.

Prince, C. L. Summary of a Meteorological Journal taken at his Observatory. From the Author.

Prindle, T. C. Wood Treatment Tests. From the Author.

Providence, R. I. Final Report of the Water Commissioners. 1874.
From the City Engineer.

Providence Public Library. Twelfth Annual Report.
From the Librarian.

Quarterly Journal of Economics. Vols. 1 and 2.
From Henry N. Rittenhouse.

Queen & Co. Catalogues. From the Company.

R. Accademia delle Scienze, Bologna. Memorie. Vol. 9.

R. Accademia di Scienze, Lettere e Belle Arti di Palermo. Atti Vol. 10.
From the Academy.

R. Accademia delle Scienze di Torino. Vol. 24.
From the Academy.

Royal Dublin Society:
Scientific Proceedings. N. P. Vol. 5, Nos. 7 and 8. Vol. 6, Nos. 1 and 2.
Scientific Transactions. Vol. 4, No. 1. From the Society.

Royal Society New South Wales:
Journal and Proceedings. Vol. 23. Part 1.
Catalogue of Library. Part 1. From the Society.

St. Joseph's Hospital. Forty-first Annual Report. From the Managers.

St. Louis Public Library. Annual Report. 1888–89.

Salem Public Library.
Opening Address of Hon. John M. Raymond.
From the Trustees.
Trustees Report. 1889. From the Librarian.

San Francisco Municipal Reports for 1888–89.
From the Clerk, Board of Supervisors.

Seismological Society of Japan. Transactions. Vol. 14.
From the Society.

Select Councils, Philadelphia. Journal, 1875. Vols. 1 and 2.
From the Clerk of Councils.

Société d' Encouragement pour l' Industrie Nationale. Annuaire pour l' Année 1890. From the Society.

Spilsbury, E. Gybbon. Wire Rope Tramways.
From the Trenton Iron Company.

State Reservation at Niagara. Sixth Annual Report of the Commissioners.
From the Secretary.

Stephenson (John) Company. Motive-Power for Street Cars.
From the Company.

Tanite Company. Descriptive Pamphlet. From the Company.

Taunton Board of Health. Report 1889. From the Board.

Ten Years in Buffalo. From McKinnon Dash & Hardware Company.

Tissier, C. & A. L'Aluminium. From R. A. Fisher.

Toisoul and Fradet. Appareil Crèmatoire. From L. F. Garrison.

Troy, N. Y. Nineteenth Annual Report of the Comptroller.
From the Comptroller.

Troy, N. Y. Thirty-fifth Annual Report of the Water Commissioners.
From the Clerk.

United States Artillery School. Hand-book of Problems in Exterior Ballistrics. Part 1. Direct Fire.
From the Commandant of School.

U. S. Bureau of Education:
Bulletin No. 1, 1890.
Circular of Information No. 1, 1890.
Rules for Dictionary Catalogue Cutter.
From the Bureau.

U. S. Bureau of Statistics. Quarterly Report of the Chief. No. 1. 1889–90.
From the Bureau.

U. S. Bureau of Statistics. Quarterly Report of the Chief. 1889–90. No. 1. From S. H. Needles.

U. S. Coast and Geodetic Survey Office. Appendix No. 12. Report for 1886. From the Office.

U. S. Department of Agriculture:

Division of Chemistry. Bulletin No. 24 and 26.

Division of Chemistry. No. 26.

Division of Entomology. Bulletin No. 20. Periodical Bulletin. March, 1890.

Division of Statistics. Report No. 1.

Experiment Station Record. November, 1889.

Report of the Statistician. No. 71.

Report of the Statistician. No. 72. From the Department.

Section of Vegetable Pathology. Quarterly Bulletin. December, 1889. From the Department.

U. S. Department of the Interior:

Report regarding the Receipt, Distribution and Sale of Public Documents. 1887–89. From the Superintendent of Documents.

U. S. Department of State:

Reports from the Consuls. February, 1890. From the Department.

U. S. Fish Commission. Bulletin. Vol. 8. From the Commission.

U. S. Hydrographic Office. Pilot Chart of the North Atlantic Ocean. April, 1890. From the Office.

U. S. Hydrographic Office. Pilot Chart of the North Atlantic Ocean. May, 1890. From the Philadelphia Office.

U. S. National Museum. Bulletin. No. 32. From the Smithsonian Institution.

U. S. Patent Office. Specifications and Drawings. January and February, 1889. From the Office.

U. S. Patent Office. Specifications and Drawings. March, 1889. From the Office.

U. S. Signal Office. Tri-daily Meteorological Record. September, 1878.

Extract No. 4 from the Annual Report. 1889.

Tri-daily Meteorological Record, October. 1878. From the Office.

U. S. Treasury Department. Annual Report of the Secretary of the Treasury for 1889. From the Department.

U. S. War Department:

Annual Report of the Chief of Ordnance. 1889. From the Chief.

Official Army Register. 1890. From the Adjutant-General.

University of Wisconsin. Agricultural Experiment Station. Bulletin No. 22. From the Station.

"Vesuvius." Photograph of the United States Dynamite Cruiser. From William O. Griggs, M.D.

Vischer, Hubert and Luther Wagoner. On the Strains in Curved Masonry Dams. From the Authors.

Walker, Sons & Co. Specimens of Rubber, Brass and Steel Stamps. From the Company.

Washington Observations. 1884. Appendix I. Catalogue of Stars. From the U. S. Naval Observatory.

Waterbury, Conn. Seventeenth to Twenty-second Annual Reports of the Board of Water Commissioners. From the Engineers.

Waterbury, Conn. Twenty-third Annual Report of the Board of Water Commissioners for 1889. From the Engineer.

Waterhouse, S. The Western Movement of Capital. From the Author.

Water Works, Springfield, O. Ninth Annual Report. From the Secretary.

Watuppa Water Board, Fall River, Mass. Sixteenth Annual Report. From the Board.

Webber, Samuel. Notes on the Comparative Loss by Friction in a Transmitting Dynamometer under Different Loads and Speeds. From Francis Leclere.

Wiedemann, A. Lebensbilder aus der Assekuranz-Geschichte. From S. H. Needles.

Wiley & Sons. Catalogue. Part 5. From John Wiley & Sons.

Wiley, John, & Son. Complete Catalogue of the Publications:

I. Engineering.
II. Materials of Engineering.
III. Bridges, Roofs, Trusses and Arches.
IV. Hydraulics.

From John Wiley & Sons.

Willcox, Joseph. Paper on Evolution. From the Author.

Wisconsin Academy of Sciences, Arts and Letters. Transactions. Vol. 7. From the State Historical Society of Wisconsin.

Wisconsin State Historical Society. Proceedings of the Thirty-seventh Annual Meeting. From the Society.

Wood, H. C. The Medical Profession, the Medical Sects, the Medical Law. From the Author.

Wootten Fast Passenger Engine. Illustration. From J. Snowden Bell.

Worcester Polytechnic Institute. Twentieth Annual Catalogue. From the Institute.

Worthington High Duty Pumping Engine at Exposition Universelle, 1889. From Henry R. Worthington.

Yale University. Transactions of the Astronomical Observatory. Vol. 1. Part 2. From the University.

Zoölogical Society of Philadelphia. Eighteenth Annual Report. From the Society.

Zurcher, Max A. An Improved System in the Construction of Railway Cars. From the Author.

Franklin Institute.

[*Proceedings of the Stated Meeting, held Wednesday, May 21, 1890.*]

HALL OF THE FRANKLIN INSTITUTE,
PHILADELPHIA, May 21, 1890.

JOSEPH M. WILSON, President, in the Chair.

Present, ninety-two members and eight visitors.

Additions to membership reported since last meeting, nineteen.

The Actuary reported a vacancy in the Board of Managers, caused by the election of Mr. EDWARD LONGSTRETH to the office of Vice-President. The vacancy was filled by the election of Mr. S. LLOYD WIEGAND.

He also reported a resolution of the Board, recommending that a set of the JOURNAL be presented to the University of Toronto, the buildings and library of which Institution had been destroyed by fire. The recommendation was unanimously approved.

A memoir of the late Mr. FREDERIC GRAFF, prepared by a special committee of the Board for publication in the JOURNAL, was read by the Secretary, and was ordered to be spread upon the minutes. (The memoir appears elsewhere in this impression.)

Mr. CARL HERING, Delegate of the INSTITUTE to the Paris World's Fair of 1889, presented an oral report of the progress in the electrical arts as shown at the Exhibition. The Secretary presented his monthly report.

Adjourned. WM. H. WAHL, *Secretary*.

PENNSYLVANIA STATE WEATHER SERVICE.

MONTHLY WEATHER REVIEW

FOR NOVEMBER, 1889.

Prepared under the Direction of the Committee on Meteorology of the FRANKLIN INSTITUTE.

HALL OF THE FRANKLIN INSTITUTE,

PHILADELPHIA, November 30, 1889.

TEMPERATURE.

The mean temperature of sixty-six stations for the month of November, was 41°·9, which is from 2° to 3° above the normal, and the same as that of November, 1888. The mean of the daily maximum and minimum, 48°·8 and 34°·7, gives a mean temperature of 41°·8, and an average daily range of 14°·1.

The highest temperatures reported during the month were Greensburg, 73°; Annville, 71°, and Centre Valley, 71°. The lowest were Dyberry, 10°; Somerset, 10°; Coudersport, 10°; Lock Haven, 12°; Wellsboro, 12°, and Columbus, 12°. The warmest period of the month was on the 1st, 2d and 3d, and the coldest on the 17th and 30th.

Total excess in temperature during November at Philadelphia, 112°.

Total excess in temperature during November at Erie, 82°.

Total excess in temperature since January 1st at Philadelphia, 334°.

Total excess in temperature since January 1st at Erie, 181°.

BAROMETER.

The mean pressure for the month, 30·08, is about ·03 above the normal. The highest, 30·690, occurred at Philadelphia on the 16th, and the lowest, 29·370, at Erie on the 22d.

PRECIPITATION.

The average precipitation for the State was 6·72 inches, which is double the usual quantity for November. As there was only a slight excess in the northwestern portion of the State, this ratio was more in other parts. The greatest totals were Girardville, 10·16; Meyerstown, 9·99; Westchester, 9·91; Eagles Mere, 9·27; Pottstown, 9·15, and Lancaster, 9·02 inches. Excessive rains occurred on the 18th and 19th, which caused heavy freshets along the Susquehanna, that carried away railroad bridges and rafts of lumber.

The snow fall during the month was light.

Total excess in precipitation during November at Philadelphia, 3·02 inches.

Total excess in precipitation during November at Erie, 20·2 inches.

Total excess in precipitation since January 1st at Philadelphia, 12.33 inches.

Total excess in precipitation since January 1st at Erie, 5·02 inches.

WIND AND WEATHER.

The prevailing wind was from the west.

The month may be characterized as warm and wet, with an unusual number of cloudy and unpleasant days.

Average Number.—Rainy days, 15; clear days, 5; fair days, 8; cloudy days, 17.

MISCELLANEOUS PHENOMENA.

Thunder-storms.—Quakertown, 27th; Mauch Chunk, 27th; Coatesville, 27th; Catawissa, 27th; Myerstown, 27th; Annville, 3d; Centre Valley, 27th; Girardville, 27th.

Hail.—Westtown, 9th; Eagles Mere, 14th; Wellsboro, 27th; Dyberry, 27th; Lewistown, 27th.

Snow.—Charlesville, 15th, 26th, 28th; Reading, 15th, 29th; Altoona, 28th; Blue Knob, 14th, 15th, 20th, 21st, 22d, 23d, 26th, 28th, 29th, 30th; Hollidaysburg, 15th, 20th, 28th, 29th; Le Roy, 15th, 27th, 29th, 30th; Quakertown, 29th, 30th; Johnstown, 15th, 28th; Emporium, 15th, 27th, 28th, 29th, 30th; Mauch Chunk, 15th, 19th, 30th; State College, 5th, 28th, 29th, 30th; Phillipsburg, 15th, 28th, 29th; Coatesville, 29th, 30th; Rimersburg, 15th, 20th, 22d, 26th, 28th, 29th; Grampian Hills, 28th, 29th, 30th; Catawissa, 29th, 30th; Uniontown, 15th, 20th, 28th; Petersburg, 15th, 28th, 29th; Indiana, 15th, 26th, 27th, 28th, 29th; Lancaster, 29th; New Castle, 28th; Myerstown, 29th; Annville, 29th; Centre Valley, 29th, 30th; Drifton, 28th, 30th; Wilkes-Barre, 29th; Greenville, 5th, 15th, 16th, 17th, 27th, 28th, 29th, 30th; Bethlehem, 28th, 29th, 30th; New Bloomfield, 28th, 29th; Coudersport, 27th, 28th; Girardville, 29th, 30th; Selins Grove, 15th, 28th, 29th; Eagles Mere, 5th, 12th, 15th, 20th, 21st, 23d, 28th, 29th; Wellsboro, 29th, 30th; Columbus, 5th, 15th, 27th, 28th, 29th, 30th; Canonsburg, 28th, 29th; Dyberry, 15th, 26th, 27th, 28th, 29th, 30th; Honesdale, 29th, 30th; Lewistown, 30th; Greensburg, 20th, 28th, 29th.

Frost.—Gettysburg, 4th, 5th, 6th, 17th, 18th, 26th, 27th, 28th, 29th, 30th; Charlesville, 4th, 5th, 23d, 26th; Reading, 4th, 7th; Hollidaysburg, 11th, 24th; Wysox, 3d, 6th, 7th, 10th, 11th, 12th, 15th, 18th, 21st, 24th, 30th; Forks of Neshaminy, 5th, 7th, 16th, 17th; Quakertown, 4th, 5th, 6th, 7th, 12th, 16th, 17th, 24th, 26th, 30th; Emporium, 4th, 5th, 7th, 16th, 17th, 24th, 26th; Mauch Chunk, 7th, 17th; State College, 4th, 5th, 15th, 17th, 24th, 26th; Phillipsburg, 4th, 5th, 17th, 24th; Coatesville, 4th, 5th, 6th, 7th, 16th, 17th, 21st, 24th, 25th; Westtown, 4th, 7th, 17th, 26th; Grampian Hills, 4th, 24th, 25th, 26th; Catawissa, 4th, 5th, 7th, 16th, 17th, 26th; Carlisle, 4th, 7th, 17th; Uniontown, 4th, 5th; Chambersburg, 4th, 7th, 16th, 17th, 24th, 26th; Huntingdon 4th, 5th, 7th, 17th, 24th, 26th; Petersburg, 3d, 4th, 17th, 24th, 26th, 30th; Indiana, 3d, 4th, 5th, 6th, 7th, 11th,

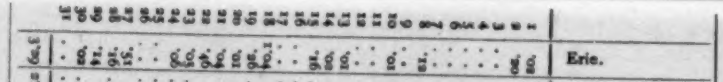
County.	Station.	Elevation above Sea Level (feet).	Barometer Reduced to Sea Level.			Temperature.													Relative Humidity.	Dew Point.	Precipit	
							Maximum.		Minimum.				Daily Range.									
			Mean.	Highest.	Lowest.	Mean.	Highest.	Date.	Lowest.	Date.	Mean of Maximum.	Mean of Minimum.	Mean.	Greatest.	Date.	Least.	Date.			Total Inches.	Total Snowfall During Month.	
Adams,[1]	Gettysburg,	624	. . .	. . .	. . .	40·6	66·0	1	20·5	17	44·1	34·0	10·1	33·0	7	1·0	8	. . .	. . .	6·47	. . .	
Allegheny,[1]	Pittsburgh,	847	30·080	30·647	29·448	43·5	69·0	2	20·0	30	49·7	37·3	12·4	25·0	24	4·0	23	81·0	37·8	4·61	. . .	
Bedford,	Charlesville,	1,300	. . .	. . .	. . .	39·5	64·5	24	16·5	30	46·7	30·7	16·0	42·0	24	3·0	8	87·5	36·8	5·03	. . .	
Berks,[1]	Reading,	304	30·060	30·577	29·454	42·8	67·0	3	18·0	17	50·4	35·2	15·2	29·0	3	7·0	9	93·5	41·2	8·88	. . .	
Blair,[2]	Altoona,	1,181	. . .	. . .	. . .	45·7	62·0	2, 3	25·0	17	54·7	38·8	13·9	23·0	24	6·0	14	75·4	38·0	4·02	. . .	
Blair,	Blue Knob,	2,100	. . .	. .	. . .	40·2	. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	8·47	11·10	
Blair,	Hollidaysburg,	947	. . .	. . .	. . .	41·3	67·0	3	18·0	17, 30	48·3	32·0	16·3	36·0	24	7·0	29	86·0	38·0	6·00	. . .	
Blair,	Tipton,	915	. . .	. . .	. . .	40·9	65·0	1	20·0	17	40·7	35·2	5·5	27·0	16	1·0	13	. . .	. . .	6·12	. . .	
Bradford,	Wysox,	728	30·090	30·697	29·339	39·0	60·4	5	13·0	17	45·3	31·9	13·4	30·5	4	3·0	13	81·8	34 9	5·02	. . .	
Bradford,	Le Roy,	1,400	. . .	. . .	. . .	38·6	57·0	2	14·0	17	43·2	33·4	9·8	22·0	7	1·0	1	. . .	. . .	5·80	1·50	
Bucks,	Forks of Neshaminy,	. . .	. . .	. . .	. . .	43·4	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	7·43	. . .	
Bucks,	Quakertown,	536	30·070	30·610	29·430	42·4	64·0	3	22·0	16	51·4	35·0	16·4	28·2	12	4·8	8	82·1	37·1	8·88	. . .	
Cambria,	Johnstown,	1,184	30·080	30·615	29·550	41·4	67·0	1	19·0	30	49·9	34·7	15·2	31·0	24	4·0	20	. . .	. . .	5·33	. . .	
Cameron,	Emporium,	1,030	. . .	. . .	. . .	41·7	60·0	2, 3	15·0	17	48·5	32·5	16·0	32·0	7	5·0	13	. . .	. . .	5·11	. . .	
Carbon,[1]	Mauch Chunk,	550	. . .	. . .	. . .	42·7	67·0	4	22·0	28	50·1	35·3	14·8	32·0	7	5·5	8	. . .	. . .	8·18	. . .	
Centre,	State College—																					
	Agricultural Experiment Station,	1,191	30·049	30·663	29·372	39·5	60·0	1, 2	17·0	17	41·2	33·2	8·0	26·0	24	3·0	13	85·0	35·0	6·48	. . .	
Centre,	Phillipsburg,	1,350	. . .	. . .	. . .	37·3	65·0	1, 2	14·0	17	47·1	29·1	18·0	32·0	24	8·0	8	. . .	. . .	5·22	1·00	
Chester,	West Chester,	455	30·074	30·668	29·431	43·7	63·5	1, 3	23·0	17	50·9	37·2	13·7	28·0	7	3·5	8	79·0	37·5	6·91	. . .	
Chester,	Coatesville,	380	. . .	. . .	. . .	42·7	68·5	1	19·0	17	52·8	34·8	18·0	38·0	7	6·0	13	. . .	. . .	8·60	. . .	
Chester,[1]	Kennett Square,	275	. . .	. . .	. . .	44·0	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	8·92	. . .	
Chester,[1]	Westtown,	350	30·062	30·633	29·428	44·0	67·0	3, 23	20·0	17	54·0	34·0	20·0	37·0	7	8·0	13	. . .	. . .	8·13	. . .	
Clarion,	Rimersburg,	1,500	. . .	. . .	. . .	39·4	64·0	2	16·0	29	43·8	35·2	8·6	22·0	12	2·0	13	. . .	. . .	. . .	1·50	
Clarion,	Clarion—																					
	State Normal School,	1,530	. . .	. . .	. . .	43·0	66·0	2	16·0	29	57·3	28·7	28·6	. . .	. . .	. . .	. . .	76·4	36·0	3·73	. . .	
Clearfield,	Grampian Hills,	1,450	. . .	. . .	. . .	38·2	58·0	1, 2	16·0	30	43·3	33·1	10·2	26·0	24	2·0	29	. . .	. . .	3·80	3·00	
Clinton,	Lock Haven,	560	. . .	. . .	. . .	43·0	62·0	1	12·0	17	48·0	34·0	14·0	31·0	4	2·0	20	. . .	. . .	6·96	. . .	
Columbia,	Catawissa,	491	. . .	. . .	. . .	44·3	67·0	19	21·5	17	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	6·95	. . .	
Crawford,	Meadville—																					
	Allegheny College,	1,050	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	
Cumberland,	Carlisle,	480	. . .	. . .	. . .	42·6	63·0	1	21·5	17	50·2	36·0	14·2	35·5	7	3·0	8	90·0	39·8	9·03	. . .	
Dauphin,[1]	Harrisburg,	361	30·114	30·687	29·490	42·4	62·0	1	24·0	17	47·7	38·0	9·7	22·0	7	2·0	8	81·0	36·4	6·59	. . .	
Delaware,	Swarthmore—																					
	Swarthmore College,	190	30·077	30·633	29·470	44·3	66·4	1	22·0	17	52·7	36·0	16·7	26·0	2	7·0	11	80·8	38·0	6·74	. . .	
Erie,[1]	Erie,	681	30·050	30·650	29·370	42·5	68·0	2	25·0	17	48·1	36·9	11·2	23·0	12	4·0	1	84·0	36·0	3·29	. . .	
Fayette,	Uniontown,	1,000	30·037	30·511	29·572	44·1	68·0	1, 2	20 0	30	50·2	37·0	13·2	30·0	24	5·0	29	84·7	40·0	8·90	. . .	
Forrest,	Tionesta,	1,057	. .	. . .	. . .	39·7	68·0	2	18·0	16	48·4	34·1	14·3	34·0	7	3·0	21	. . .	. . .	4·20	. . .	
Franklin,[1]	Chambersburg—																					
	Wilson Female College,	618	30·163	30·659	29·556	41·1	68·0	1	20·0	17	48·5	33·7	14·8	32·0	7	7·0	13	82·5	36·7	5·73	. . .	
Fulton,	McConnellsburg,	875	. . .	. . .	. . .	41·4	66·0	1	22·0	26	49·9	34·8	15·1	36·0	7	5·0	20	83·6	37·5	6·51	. . .	
Huntingdon,[1]	Huntingdon—																					
	The Normal College,	650	. . .	. . .	. . .	40·6	65·0	1	17·0	17	49·9	33·5	16·4	36·0	7	5·0	13	. . .	. . .	6·65	. . .	
Huntingdon,	Petersburg,	700	. . .	. . .	. . .	41·4	69·0	1	19·0	17	47·5	36·4	11·1	31·0	7	1·0	29	. . .	. . .	7·25	. . .	
Indiana,	Indiana—																					
	State Normal School,	1,380	. . .	. . .	. . .	40·8	66·0	1	14·5	30	46·5	33·4	14·1	30·5	24	2·6	20	85·2	36·1	5·20	4·00	
Lancaster,	Lancaster,	471	30·084	30·629	29·484	43·2	65·0	2, 3	20·0	30	51·0	36·0	15·0	24·0	4	3·5	11	92·8	41·6	9·02	. . .	
Lawrence,	New Castle,	932	. . .	. . .	. . .	42·4	68·0	2	18·0	26	48·9	32·7	16·2	33·0	12	6·0	22	. . .	. . .	2·89	1·00	
Lebanon,	Myerstown,	474	30·033	30·587	29·452	41·5	57·7	2	27·8	29	58·0	34·5	15·5	31·5	7	7·3	13	94·3	38·6	9·93	. . .	
Lebanon,	Annville—																					
	Lebanon Valley College,	339	. . .	. . .	. . .	46·3	71·0	1	31·0	29, 30	. . .	. . .	. . .	. . .	. . .	. . .	. . .	78·9	40·1	. . .	. . .	
Lehigh,	Centre Valley,	348	. . .	. . .	. . .	46·1	71·0	7	27·0	30	55·0	39·1	15·9	37·0	7	3·0	22	. . .	. . .	7·88	. . .	
Lehigh,[1]	Lynnport,	350	. . .	. . .	. . .	42·4	65·0	3, 4	16·5	17	50·3	34·5	15·8	27·5	17	8·0	29	. . .	. . .	8·50	. . .	
Luzerne,	Drifton—																					
	Drifton Hospital,	1,655	. . .	. . .	. . .	40·1	60·0	2	17·0	17	47·3	34·0	13·3	25·0	17	5·0	22	. . .	. . .	7·39	. . .	
Luzerne,[1]	Wilkes-Barre,	575	. . .	. . .	. . .	42·0	66·0	3	18·0	17	48·5	36·0	12·5	26·5	4	4·5	13	. . .	. . .	6·39	. . .	
Lycoming,[1]	Nisbet,	550	. . .	. . .	. . .	41·4	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	7·70	. . .	
Mercer,[1]	Greenville—																					
	Thiel College,	1,000	30·000	30·608	29·361	41·5	66·5	2	16·3	30	48·9	34·1	14·8	28·2	24	6 6	13	94·9	36·9	2·72	4·00	
Mifflin,	Lewistown (16 days),	500	. . .	. . .	. . .	39·1	52·0	19	20·5	17	45·2	33·2	12·0	27·5	17	6·0	29	86·9	34·8	4·09	. . .	
Montgomery,	Pottstown,	150	. . .	. . .	. . .	46·0	64·3	1	22·0	17	53·0	38·0	15·0	27·0	7	5·0	5	81·0	40·5	9·15	. . .	
Northampton,	Bethlehem,	360	. . .	. . .	. . .	45·0	66·0	3	21·0	17	51·0	38·0	13·0	22·0	15	5·0	8	80·0	39·0	8·71	. . .	
Perry,	New Bloomfield,	400	. . .	. . .	. . .	41·0	64·0	3	19·0	17	49·0	35·0	14·0	34·0	7	4·0	13	. . .	. . .	7·31	. . .	
Philadelphia,	Philadelphia—																					
	Drexel Building,	. . .	. . .	. . .	. . .	48·0	65·0	3	28·0	30	54·9	41·1	13·8	21·0	7	5·0	9	. . .	. . .	. . .	. . .	
Philadelphia,[1]	Philadelphia—																					
	Signal Office,	117	30·100	30·690	29·440	47·0	65·0	3	27·0	30	53·1	40·8	12·3	21·0	27	4·0	20	77·0	39·0	6·76	. . .	
Pike,	Coudersport,	1,670	. . .	. . .	. . .	41·5	59·0	11,	10·0	17	43·4	33·1	10·3	27·0	4	2·0	20	86·1	36·4	3·80	2·00	
Schuylkill,	Girardville,	1,000	30·090	30·657	29·498	41·4	65·0	3	21·0	17	48·4	34·5	13·9	27·0	3	4·0	20	. . .	. . .	10·16	. . .	
Snyder,	Selins Grove,	445	. . .	. . .	. . .	43·0	65·0	3	25·0	7	50·3	32·2	18·3	33·0	7	8·0	29	82·8	37·4	9·13	. . .	
Somerset,	Somerset,	2,250	. . .	. . .	. . .	40·4	70·0	4	10·0	30	49·3	31·5	17·8	39·0	4	4·0	20	89 0	36·0	7·22	. . .	
Sullivan,	Eagles Mere,	2,060	30·106	30·521	29·594	37·3	60·0	2	16·0	30	41·9	31·4	10·5	21·0	18	3·0	13	83·5	33·3	9·27	4·00	
Tioga,	Wellsboro,	1,327	30·058	30·658	29·414	38·1	56·0	2	22·0	17	44·2	33·3	10·9	34·0	19	3·0	1	82·2	33 0	9·07	. . .	
Union,[1]	Lewisburg,	450	. . .	. . .	. . .	40·3	61·0	2	17·0	17	48·4	32·3	16·1	33·0	7	5 0	22	. . .	. . .	7·13	. . .	
Warren,	Columbus,	1,410	. . .	. . .	. . .	39·1	63·0	12	12·0	17	44·9	33·2	11·7	32·0	17	2·0	29	. . .	. . .	4·00	3·00	
Washington,	Canonsburg,	950	. . .	. . .	. . .	39·8	69·0	1	19·0	19, 20	47·3	31·4	15·9	32·0	7	5·0	13	79·8	35·1	4·91	·75	
Wayne,	Dyberry,	1,100	. . .	. . .	. . .	37·8	61·0	3	10·0	17	45·0	31·9	13·1	35·0	17	2·0	13	. . .	. . .	5·70	·50	
Wayne,	Honesdale,	1,000	. . .	. . .	. . .	41·2	61·0	3	14·0	17	46·9	35·5	11·4	28·0	17	4·0	13	73·2	36·5	5·31	·25	
Westmoreland,	Greensburg,	1,175	. . .	. . .	. . .	43·0	73·0	1	18·5	30	55·1	34·6	20·5	48·0	1	9·0	21	77·7	27·0	8·30	2·50	
Wyoming,[1]	South Eaton	660	. . .	. . .	. . .	42·7	61·0	3	14·0	17	47·8	37·5	10·3	29·0	17	3·0	13	. . .	. . .	5·52	. . .	
York,[1]	York,	385	30·085	30·666	29·519	43·1	68·0	3	23·5	17	53·1	36·5	16·6	32·5	7	6·0	13	81·4	37·4	8·28	. . .	

[1] Observations taken at 8 A. M. and 8 P. M. [2] Observations taken at 12 Noon.

Temperature.									Relative Humidity.	Dew Point.	Precipitation.			
Minimum.		Mean of Maximum.	Mean of Minimum.	Daily Range.										
Lowest.	Date.			Mean.	Greatest.	Date.	Least.	Date.			Total Inches.	Total Snowfall During Month.	Depth of Snow on Ground at End of Month.	Number of Days
20·5	17	44·1	34·0	10·1	33·0	7	1·0	8	. . .	. . .	6·47	. . .	. . .	16
20·0	30	49·7	37·3	12·4	25·0	24	4·0	23	81·0	37·8	4·61	. . .	. . .	19
16·5	30	46·7	30·7	16·0	42·0	24	3·0	8	87·5	36·8	5·03	. . .	. . .	11
18·0	17	50·4	35·2	15·2	29·0	3	7·0	9	93·5	41·2	8·88	. . .	. . .	14
25·0	17	54·7	38·8	13·9	23·0	24	6·0	14	75·4	38·0	4·02	. . .	. . .	14
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	8·47	11·10	6·30	15
18·0	17, 30	48·3	32·0	16·3	36·0	24	7·0	29	86·0	38·0	6·00	. . .	. . .	17
20·0	17	40·7	35·2	5·5	27·0	16	1·0	13	. . .	. . .	6·12	. . .	. . .	16
13·0	17	45·3	31·9	13·4	30·5	4	3·0	13	81·8	34·9	5·02	. . .	. . .	15
14·0	17	43·2	33·4	9·8	22·0	7	1·0	1	. . .	. . .	5·80	1·50	·50	19
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	7·43	. . .	. . .	11
22·0	16	51·4	35·0	16·4	28·2	12	4·8	8	82·1	37·1	8·88	. . .	. . .	17
19·0	30	49·9	34·7	15·2	31·0	24	4·0	20	. . .	. . .	5·33	. . .	. . .	20
15·0	17	48·5	32·5	16·0	32·0	7	5·0	13	. . .	. . .	5·11	. . .	. . .	15
12·0	28	50·1	35·3	14·8	32·0	7	5·5	8	. . .	. . .	8·18	. . .	. . .	15
17·0	17	41·2	33·2	8·0	26·0	24	3·0	13	85·0	33·0	6·48	. . .	. . .	18
14·0	17	47·1	29·1	18·0	32·0	24	8·0	8	. . .	. . .	5·22	1·00	. . .	20
13·0	17	50·9	37·2	13·7	28·0	7	3·5	8	79·0	37·5	9·91	. . .	. . .	18
19·0	17	52·8	34·8	18·0	38·0	7	6·0	13	. . .	. . .	8·60	. . .	. . .	16
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	8·92	. . .	. . .	13
20·0	17	54·0	34·0	20·0	37·0	7	8·0	13	. . .	. . .	8·13	. . .	. . .	12
16·0	29	43·8	35·2	8·6	22·0	12	2·0	13	. . .	. . .	. . .	1·50	1·00	. .
16·0	29	57·3	28·7	28·6	. . .	. . .	. . .	. . .	76·4	36·0	3·73	. . .	. . .	. .
16·0	30	43·3	33·1	10·2	26·0	24	2·0	29	. . .	. . .	3·86	3·00	2·00	18
12·0	17	48·0	34·0	14·0	31·0	4	2·0	20	. . .	. . .	6·96	. . .	. . .	16
11·5	17	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	6·95	. . .	. . .	15
. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. .
11·5	17	50·2	36·0	14·2	33·5	7	3·0	8	90·0	39·8	9·03	. . .	. . .	16
14·0	17	47·7	38·0	9·7	22·0	7	2·0	8	81·0	36·4	6·59	. . .	. . .	18
12·0	17	52·7	36·0	16·7	26·0	2	7·0	21	80·8	38·0	6·74	. . .	. . .	12
15·0	17	48·1	36·9	11·2	23·0	12	4·0	1	84·0	36·0	3·29	. . .	. . .	20
10·0	30	50·2	37·0	13·2	30·0	24	5·0	29	84·7	40·0	8·90	. . .	. . .	17
18·0	16	48·4	34·1	14·3	34·0	7	3·0	21	. . .	. . .	4·20	. . .	. . .	7
10·0	17	48·5	33·7	14·8	32·0	7	7·0	13	82·5	36·7	5·73	. . .	. . .	16
12·0	20	49·9	34·8	15·1	36·0	7	5·0	20	83·6	37·5	6·51	. . .	. . .	14
17·0	17	49·9	33·5	16·4	36·0	7	5·0	13	. . .	. . .	6·65	. . .	. . .	16
19·0	17	47·5	36·4	11·1	31·0	7	1·0	29	. . .	. . .	7·25	. . .	. . .	14
14·5	30	46·5	32·4	14·1	30·5	24	2·6	20	85·2	36·1	5·20	4·00	1·00	19
10·0	30	51·0	36·0	15·0	24·0	4	3·5	11	92·8	41·6	9·02	. . .	. . .	14
18·0	26	48·9	32·7	16·2	33·0	12	6·0	22	. . .	. . .	2·89	1·00	. . .	9
17·8	29	50·0	34·5	15·5	31·5	7	7·3	13	94·3	38·6	9·99	. . .	. . .	15
11·0	29, 30	. . .	. . .	. . .	. . .	. . .	. . .	. . .	78·9	40·1	. . .	. . .	. . .	10
17·0	30	55·0	39·1	15·9	37·0	7	3·0	23	. . .	. . .	7·88	. . .	. . .	14
16·5	17	50·3	34·5	15·8	27·5	17	8·0	29	. . .	. . .	8·50	. . .	. . .	. .
17·0	17	47·3	34·0	13·3	25·0	17	5·0	22	. . .	. . .	7·39	. . .	. . .	15
18·0	17	48·5	36·0	12·5	26·5	4	4·5	13	. . .	. . .	6·39	. . .	. . .	15
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	7·70	. . .	. . .	12
16·3	30	48·9	34·1	14·8	28·2	24	6·6	13	94·9	36·9	2·72	4·00	. . .	14
10·5	17	45·2	33·2	12·0	27·5	17	6·0	29	86·9	34·8	4·09	. . .	. . .	9
12·0	17	53·0	38·0	15·0	27·0	7	5·0	5	81·0	40·5	9·15	. . .	. . .	13
11·0	17	51·0	38·0	13·0	22·0	15	5·0	8	80·0	39·0	8·71	. . .	. . .	12
9·0	17	49·0	35·0	14·0	34·0	7	4·0	13	. . .	. . .	7·31	. . .	. . .	14
18·0	30	54·9	41·1	13·8	21·0	7	5·0	9	. . .	. . .	. . .	. . .	. . .	. .
17·0	30	53·1	40·8	12·3	22·0	27	4·0	20	77·0	39·0	6·76	. . .	. . .	15
20·0	17	43·4	33·1	10·3	27·0	4	2·0	20	86·1	36·4	3·80	2·00	. . .	10
11·0	17	48·4	34·5	13·9	27·0	3	4·0	20	. . .	. . .	10·16	. . .	. . .	17
15·0	7	50·3	32·2	18·3	33·0	7	8·0	29	82·8	37·4	9·13	. . .	. . .	15
20·0	30	49·3	31·5	17·8	39·0	4	4·0	20	89·0	36·0	7·22	. . .	. . .	16
16·0	30	41·9	31·4	10·5	21·0	18	3·0	13	83·5	33·3	9·27	4·00	. . .	14
12·0	17	44·2	33·3	10·9	34·0	19	3·0	1	82·2	33·0	9·07	. . .	. . .	18
17·0	17	48·4	32·3	16·1	33·0	7	5·0	28	. . .	. . .	7·13	. . .	. . .	14
12·0	17	44·9	33·2	11·7	32·0	17	2·0	29	. . .	. . .	4·00	3·00	2·00	16
9·0	19, 20	47·3	31·4	15·9	32·0	7	5·0	13	79·8	35·1	4·91	·75	. . .	18
10·0	17	45·0	31·9	13·1	35·0	17	2·0	13	. . .	. . .	5·70	·50	. . .	15
14·0	17	46·9	35·5	11·4	28·0	17	4·0	13	73·2	36·5	3·31	·95	. . .	15
15·5	30	55·1	34·6	20·5	48·0	1	9·0	21	77·7	27·0	8·30	2·50	·50	11
14·0	17	47·8	37·5	10·3	20·0	17	3·0	13	. . .	. . .	5·52	. . .	. . .	14
13·5	17	53·1	36·5	16·6	32·5	7	6·0	13	81·4	37·4	8·28	. . .	. . .	17

IPITATION.		NUMBER OF DAYS.			WIND.			OBSERVERS.
	Depth of Snow on Ground at End of Month.	Number of Days Rainfall.	Clear.	Fair.	Cloudy.	PREVAILING DIRECTION. 7 A. M.	2 P. M.	9 P. M.	
		16	5	6	19	W	W	W	Prof. E. S. Breidenbaugh.
		19	3	9	18	W	W	W	Oscar D. Stewart, Sgt. Sig. Corps
		11	5	8	17	NW	NW	NW	Rev. A. Thos. G. Apple.
		14	8	8	14	NW	NW	NW	C. M. Dechant, C.E.
		14	. . .	. . .	. . .	. . .	. . .	. . .	Dr. Charles B. Dudley.
	6'30	13	3	7	20	NW	NW	NW	A. H. Boyle.
		17	7	6	17	W	W	W	Prof. J. A. Stewart.
		16	. . .	. . .	. . .	SW	SW	W	Miss Cora J. Wilson.
		15	4	1	23	E	W	W	Charles Beecher.
	'50	19	2	9	19	SW	SW	SW	Geo. W. T. Warburton.
		11	10	11	9	W	NW	W	J. C. Hilsman.
		17	4	10	16	W	W	W	J. L. Heacock.
		20	3	9	18	SE	SE	SE	E. C. Lorentz.
		15	4	4	22	W	W	W	T. B. Lloyd.
		15	. . .	. . .	. . .	. . .	. . .	. . .	John J. Boyd.
		18	2	8	20	W	W	W	Prof. Wm. Frear.
		20	4	6	20	S	S	S	Geo. H. Dunkle.
		18	10	4	16	NW	NW	NW	Jesse C. Green, D.D.S.
		16	6	10	14	W	W	W	W. T. Gordon.
		13	9	7	14	N	N	N	Benj. P. Kirk.
		12	9	8	13	W	W	W	Prof. Wm. F. Wickersham.
	1'00	. . .	3	8	19	SW	SW	E	Rev. W. W. Deatrick, A.M.
		. . .	4	5	21	SW	SW	SW	C. M. Thomas, B.S.
	2'00	18	3	6	21	W	W	W	Nathan Moore.
		16	8	8	14	W	W	W	Prof. John A. Robb.
		15	. . .	. . .	. . .	. . .	. . .	. . .	Robert M. Graham.
		. . .	. . .	. . .	. . .	. . .	. . .	. . .	R. B. Derickson.
		16	3	14	13	W	W	W	J. E. Pague.
		18	4	9	17	W	W	W	Frank Ridgway, Sgt. Sig. Corps.
		12	8	11	11	W	NW	NW	Prof. Susan J. Cunningham.
		20	4	6	20	SW	SW	SW	Peter Wood, Sgt. Sig. Corps.
		17	8	10	13	NW	NW	W	Wm. Hunt.
		7	. . .	. . .	. . .	. . .	. . .	. . .	R. L. Haslet.
		16	7	8	15	W	W	W	Miss Mary A. Ricker.
		14	4	13	13	W	W	W	Thomas F. Sloan.
		16	4	9	17	NE	. . .	NW	Prof. W. J. Swigart.
		14	2	13	15	W	E	E	J. E. Rooney.
	1'00	19	3	11	16	W	W	W	Prof. S. C. Schmucker.
		14	4	13	13	W	W	W	E. E. Weller.
		9	2	7	21	E	E	E	Wm. T. Butz.
		15	6	3	21	NW	NW	NW	Wm. H. Kline.
		20	5	10	15	W	W	W	Geo. W. Bowman, A.M., Ph.D.
		14	4	11	15	NW	NW	NW	H. W. Mullen.
		. . .	. . .	. . .	. . .	. . .	. . .	. . .	John C. Muchter.
		15	. . .	. . .	. . .	NW	NW	NW	H. D. Miller, M.D.
		15	6	4	20	NW	NW	NW	A. W. Betterly.
		12	. . .	. . .	. . .	. . .	. . .	. . .	John S. Gibson, P. M.
		14	0	6	24	E	. . .	SE	Prof. S. H. Miller.
		9	3	1	12	NW	NW	NW	Culbertson & Lantz.
		13	5	13	12	NW	NW	NW	Charles Moore, D.D.S.
		12	10	2	12	W	W	W	Lerch & Rice.
		14	6	5	19	W	W	W	Frank Mortimer.
		. . .	. . .	. . .	. . .	. . .	. .	. . .	
		13	7	7	16	NW	NW	NW	Luther M. Dey, Sgt. Sig. Corps.
		10	4	3	23	W	W	W	C. L. Peck.
		17	2	13	15	W	W	W	E. C. Wagner.
		15	1	10	19	SW	SW	SW	J. M. Boyer,
		16	2	9	19	SW	SW	SW	W. M. Schrock.
		14	3	9	18	SW	SW	SW	E. S. Chase.
		18	2	4	24	S	SW	S	H. D. Deming.
		14	2	11	17	W	W	W	F. O. Whitman.
	2'00	16	5	5	20	SW	SW	SW	Wm. Loveland.
		18	5	9	16	W	W	W	A. L. Runion, M.D.
		15	4	9	17	NW	NW	NW	Theodore Day.
		15	. . .	. . .	. . .	. . .	. . .	. . .	John Torrey.
	'50	11	5	3	22	W	W	W	Hilary S. Brunot.
		14	6	5	19	NW	NW	NW	Benj. M. Hall.
		17	6	10	14	NW	NW	NW	Mrs. L. H. Grenewald.

T. F. TOWNSEND, *Sergeant Signal Corps, Assistant.*


Erie.

PRECIPITATION FOR NOVEMBER, 1889.

	Erie.	New Castle.	Greenville.	Columbus.	Pittsburgh.	Uniontown.	Clarion.	Indiana.	Johnstown.	Somerset.	Grampian Hills	Emporium.	Blue Knob.	Phillipsburg.	Petersburg.	Huntingdon.	Hollidaysburg.	Altoona.	Chambersburg.	State College.	York.	Lock Haven.	New Bloomfield.	Wellsboro.	Harrisburg.	Selins Grove.	Lancaster.	Le Roy.	Eagles Mere.	Myerstown.	Wyoz.	Catawissa.	Girardville.	Wilkes-Barre.	South Eaton.	Drifton.	Reading.	Pottstown.	West Chester.	Coatesville.	Kennett Square.	Dyberry.	Honesdale.	Quakertown.	
1	.08	..	..	..	..	.34	..	..	..	..	..	..	..	.58	..	..	..	..	..	..	..	.04	..	..	.08	..	..	..	..	..	..	..	..	..	..	..	..	..	.03	.01	..	..	..	..	..	
2	.80	.21	.35	.43	.08	..	..	.03	.15	.42	.08	.39	.30	..	.09	.30	1.06	..	..	.04	..	.20	.15	.05	.30	.10	.04	.21	.05	.04	.95	.20	.26	.40	.84	..	..	.60	.34	.05	.08	.03	.05	.22	1.00	.11	
3	..	..	..	.11	.45	.83	..	.73	.55	.71	..	.68	.80	.72	1.39	.70	.11	.63	.65	.89	.50	.85	.50	1.46	.62	.60	.48	.30	.44	.61	.09	.90	1.27	1.09	1.12	1.04	.57	.60	.68	.59	.67	1.59	.46	.81	
4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
5	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
7	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
8	..	..	..	.13	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.04	..	..	..	..	..	..	..	..	..	..	..	..	..	
9	.19	.42	.23	..	.62	1.03	..	.75	.92	.70	.55	.19	.70	.48	.61	.70	.72	.30	.50	.49	.60	.30	.35	.10	.30	.30	.39	.10	1.03	.47	.85	.55	.56	.11	.12	.82	.37	.40	.47	.46	.40	.11	.22	.34	
10	..	.07	..	..	.21	.93	..	.51	.63	1.00	.47	.04	.60	.60	.78	.80	.56	.67	.65	.50	1.65	.41	.60	.03	1.16	1.00	1.58	.20	.82	1.97	..	.90	1.11	.61	.36	.40	1.96	2.32	1.58	1.06	1.74	.58	.58	2.59	1
11	.01	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.01	..	..	..	..	..	.15	..	.04	..	.09	..	..	.09	..	..	.06	.05	..	.08	..	..	.16	..	..	..	.04	
12	..	..	..	..	.14	.28	..	.10	.07	.17	.17	.18	.10	.08	.06	..	.07	.40	.13	.05	.40	.10	.16	.16	.20	.10	.17	.17	.36	.22	.19	.09	.13	.11	.08	.10	.15	.10	.16	.08	..	.20	.09	.13	
13	.01	.40	.09	.08	.49	.95	..	..	.68	.80	.53	.74	.80	.25	.63	.65	.61	.19	.13	.53	1.55	.55	.90	.94	.86	.51	1.01	.35	.23	.63	.32	.53	1.23	.51	.26	.82	.95	1.20	1.01	1.14	1.05	.44	.45	1.01	
14	.02	..	..	.06	.03	..	..	.60	.02	..	..	..	.10	.32	..	..	..	.28	..	.04	..	..	..	..	.02	..	..	.11	..	..	.07	..	.07	.17	..	..	..	..	.06	..	..	..	.07	..	.01	
15	.16	..	.05	.12	..	..	..	..	.02	..	..	..	.60	..	..	..	.04	..	..	..	..	..	..	..	..	..	..	.05	..	..	..	..	.05	..	..	..	..	..	..	..	..	..	..	..	
16	..	..	..	..	..	..	..	.59	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
17	..	..	.08	..	.74	.51	..	.43	..	.25	..	..	.10	..	.38	.10	.38	..	..	.08	.01	..	.10	..	.24	..	.12	..	..	.04	.09	.10	.08	..	..	..	.04	..	..	.01	..	..	..	..	
18	1.04	.71	.63	1.20	.41	.03	..	.05	.07	.60	.42	.68	.80	.77	.82	1.10	.55	.60	1.33	.99	.60	.46	.75	.56	.56	.60	.96	.45	1.03	1.09	1.12	.35	1.10	.26	..	.62	.68	.65	.97	.81	.50	..	.05	.36	
19	.26	..	.12	.38	.66	.21	..	.34	.31	.50	.70	1.61	.60	.85	.62	.55	.56	.17	.70	1.33	1.06	2.51	1.60	3.96	1.26	3.56	2.33	2.38	1.64	2.26	.89	1.10	1.14	1.10	1.20	.84	2.30	1.50	2.62	1.60	2.31	.46	.50	.96	1
20	.01	.34	..	.04	.02	.63	..	.10	.21	.25	.20	.07	.23	.46	.46	.30	.25	.13	.18	.24	.12	.16	.80	.06	.10	.25	.10	.01	.86	.05	.10	.34	.16	.03	.12	.07	.09	.10	.08	.15	.13	.08	.07	.16	
21	.04	..	.10	..	.01	.13	..	.10	.11	..	.17	.04	.60	.10	.05	.18	.16	.08	..	.15	.38	.05	.40	.10	.20	.65	.26	.06	.58	.27	.41	.30	.36	.03	.24	..	.42	.40	.40	.33	.35	.34	.30	.37	
22	.46	.17	.07	.40	.16	.30	..	.22	.31	.02	.12	.13	.50	.23	.24	.05	.03	.14	.40	.08	.06	.45	.04	.26	.06	.02	..	.42	..	..	.14	.02	.03	.38	.11	..	..	..	.08	.03	..	..	.16	.05	..	
23	.05	..	.17	.31	.01	..	..	.20	.03	.15	.07	.07	.25	.04	..	..	..	..	..	..	.01	..	..	.08	.01	..	..	.05	..	..	..	..	..	.40	.01	..	..	..	..	..	..	..	..	..	..	
24	.06	..	.02	.08	..	.04	..	.10	.03	..	.04	.05	..	.01	..	..	..	..	..	.01	..	.01	..	.02	..	..	..	.01	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.04	..	..	
25	..	..	..	..	.24	.73	..	.21	.29	.55	.16	..	.30	.15	.23	.21	.15	.06	.32	.14	.35	.16	.30	..	.20	.22	.52	..	.08	.41	..	.17	.28	.09	.08	.46	.72	.65	.37	.38	.20	.05	.02	.61	
26	..	..	..	..	..	..	..	.10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
27	.51	.25	.50	.49	.20	.45	..	.19	.22	.90	..	.32	.50	.04	.89	.80	.54	.02	.65	.64	.66	.51	.80	.54	.60	.56	.37	.20	.47	1.22	.97	.85	1.36	.25	.54	.77	.24	.60	.75	.59	.62	.35	1.10	.77	1
28	.16	..	.11	.12	.10	..	..	.14	.08	.05	.10	.22	.20	.02	..	.10	.08	.35	..	.11	.33	.35	.28	.68	.34	.40	.63	.74	.69	.46	.08	.35	.37	1.15	1.11	.03	..	.60	.45	.73	.75	1.05	.37	.58	
29	.14	.32	.20	.03	.03	1.50	..	.30	.04	.15	.04	..	.35	.01	..	..	.03	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.01	..	
30	.02	..	..	.02	..	.04	..	..	..	..	.04	..	.04	.01	..	..	..	..	..	..	..	..	..	..	..	..	.04	..	..	..	..	..	..	..	.02	..	..	..	..	..	..	..	.01	..	
31	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
	3.29	2.89	2.72	4.00	4.62	8.90	3.73	5.20	5.33	7.22	3.86	5.11	8.47	5.22	7.25	6.65	6.00	4.02	5.73	6.48	8.28	6.96	7.31	9.07	6.59	9.13	9.02	5.80	9.27	9.99	5.02	6.95	10.16	6.39	5.52	7.39	8.88	9.15	9.91	8.60	8.92	5.70	5.31	8.88	6

PRECIPITATION FOR NOVEMBER, 1889.

	Harrisburg.	Selins Grove.	Lancaster.	Le Roy.	Eagles Mere.	Myerstown.	Wysox.	Catawissa.	Girardville.	Wilkes-Barre.	South Eaton.	Drifton.	Reading.	Pottstown.	West Chester.	Coatesville.	Kennett Square.	Dyberry.	Honesdale.	Quakertown.	Swarthmore.	Philadelphia.	Seisholtzville.	Frederick.	Ottsville.	Smith's Corner.
.	'02	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	'03	'01	. .	. .	1'00	. .	. .	. .	. .	. .	. .	. .
10	'04	'21	'05	'04	'95	'20	'26	'40	'84	. .	. .	'60	'34	'05	'08	'03	'05	'22	1'00	'11	'01	'10	. .	. .	. .	. .
46	.62	'60	'48	'38	'44	'61	'09	'90	1'27	1'09	1'12	1'04	'57	'60	'68	'59	'67	1'59	'46	'81	'44	'37	1'21	'64	'82	'99
.	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	'27	. .
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.	. .	. .	. .	. .	. .	. .	'04	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
10	'30	'30	'39	'10	1'03	'47	'25	'55	.56	'11	'12	'82	'37	'40	'47	'46	'40	'11	'22	'34	. .	'21	. .	. .	. .	. .
05	1'16	1'00	1'58	'20	'82	1'97	. .	'90	1'11	'61	'36	'40	1'96	2'30	1'58	1'66	1'74	'58	'58	2'59	1'35	1'26	2'63	2'63	2'10	2'78
.	. .	'15	. .	'04	. .	'02	. .	. .	'09	. .	. .	'06	'05	. .	'08	. .	'16	. .	. .	'04	'21	'04	'01	. .	'71	. .
16	'20	'10	'17	'17	'36	'22	'19	'09	'13	'11	'08	'10	'15	'10	'16	'08	. .	'20	'09	'13	'02	'02	'21	'09	'15	'08
.	. .	. .	. .	. .	'09	. .	. .	. .	. .	. .	. .	. .	. .	. .	'04	. .	. .	. .	. .	'02	. .	. .	. .	. .	. .	. .
94	'86	'51	1'01	'35	'23	'63	'32	'53	1'23	'51	'26	'82	'95	1'20	1'01	1'14	1'05	'44	'45	1'01	'82	'73	'99	1'00	'89	1'00
.	'02	. .	. .	'11	. .	. .	'07	. .	. .	'07	'17	. .	. .	. .	'06	. .	. .	'07	. .	'01	. .	. .	. .	. .	. .	. .
.	. .	. .	. .	'03	. .	. .	. .	. .	'03	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
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.	'04	. .	'12	. .	. .	. .	'09	'10	'08	. .	. .	. .	'04	. .	. .	'01	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
56	'56	'60	'96	'45	1'03	1.09	1'12	'35	1'10	'26	. .	'62	'68	'65	'97	'81	'50	. .	'05	'36	'26	'95	. .	. .	'51	. .
96	1'26	3'56	2'33	2'38	2'64	2'26	'89	1'10	1'14	1'10	1'20	'84	2'30	1'50	2'62	1'60	2'31	'46	'50	'96	1'62	'97	2'11	1'24	'50	1'19
06	'10	'25	'10	'01	'86	'05	'10	'34	'16	'03	'12	'07	'09	'10	'08	'15	'12	'08	'07	'16	. .	'08	'12	'10	'09	'08
10	'20	'65	'26	'06	'58	'27	'41	'30	'36	'03	'34	. .	'42	'40	'40	'33	'35	'34	'30	'37	'02	'27	'33	'36	'37	'33
26	'06	'02	. .	'42	. .	. .	'14	'02	'03	'38	'11	. .	. .	. .	'08	'03	. .	'16	'05	. .	'36	'03	. .	. .	. .	. .
08	'01	. .	. .	'05	. .	. .	. .	. .	. .	'40	'01	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
02	. .	. .	. .	'01	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	'04	. .	. .	. .	. .	. .	40	. .
.	'20	'22	'52	. .	'08	'41	. .	'17	'28	'09	'08	'46	'72	'65	'37	'38	'20	'05	'02	'61	. .	'11	'61	'60	'17	. .
.	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	'74	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
54	'60	'56	'37	'20	'47	1'22	'97	'85	1'36	'25	'54	'77	'24	'60	'75	'59	'62	'35	1'10	'77	1'00	'60	. .	. .	. .	. .
58	'34	'40	'68	'74	'69	'46	'08	'35	'37	1'15	1'11	'03	. .	'60	'45	'73	'75	1'05	'37	'58	'63	1'08	1'48	'97	1'89	2'61
.	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	'01	. .	. .	. .	. .	. .	. .	. .
.	. .	. .	. .	'04	. .	. .	. .	. .	. .	. .	. .	'02	. .	. .	. .	. .	. .	. .	. .	'01	. .	. .	. .	. .	. .	. .
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27	6'59	9'13	9'02	5'80	9'27	9.99	5'02	6'95	10'16	6'39	5'52	7'39	8'88	9'15	9'91	8'60	8'92	5'70	5'31	8'88	6'74	6'76	9'70	7'63	8'87	9'06

Frederick.	Ottsville.	Smith's Corner.	Doylestown.	Lansdale.	Forks of Nesham'y.	Germantown.	Point Pleasant.	Bethlehem.	Canonsburg.	Carlisle.	Centre Valley.	McConnellsburg.	Westtown.	Lewisburg.	Mauch Chunk.	Nisbet.	Charlesville.	Lynnport.	Tionesta.	Gettysburg.	Lewistown.	Greensburg.	Tipton.	Coudersport.
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	'03	. .	. .	. .	'10	'01	. .	. .	. .	. .	. .	. .	. .	. .	'10
'64	'82	'99	'63	'98	'55	'59	'97	1'07	. .	'70	1'03	'50	'55	1'17	1'48	'90	. .	. .	. .	'05	. .	'03	. .	. .
. .	'27	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	'35	. .	. .	. .	. .	'57	. .	. .	. .	'80
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
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2'63	2'10	2'78	2'15	2'10	1'98	1'56	2'40	1'25	1'03	'26	'25	'62	. .	'50	'16	. .	1'18	. .	. .	'53	. .	1'48	. .	'80
. .	'71	. .	. .	. .	. .	. .	'15	. .	'05	. .	'08	. .	. .	. .	'01	. .	. .	. .	. .	1'05	. .	1'48	. .	. .
'09	'15	'08	'90	'40	'05	'05	'01	'12	'03	'13	'07	'15	'05	'01	'16	'10	'16	. .	. .	'11	. .	. .	. .	. .
1'00	'89	1'00	'95	'60	'93	'87	1'05	'95	'81	'99	'84	1'27	'90	'24	1'00	'40	'87	. .	. .	'01	. .	. .	. .	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	'12	. .	. .	. .	'24	. .	. .	. .	. .	. .	1'10	. .	1'82	. .	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	'03	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	'08	. .	'80
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	1'13	. .	. .	'26	. .	'60	'09	'80	'38	. .	. .	111	'07	1'40	. .	. .
1'24	'50	1'19	1'68	1'04	1'17	2'12	'96	'42	'38	1'68	'58	'43	2'90	2'46	1'14	2'90	'51	. .	. .	'80	'76	'06	. .	. .
'10	'09	'08	'80	'73	'06	. .	'07	'08	'15	'16	'09	'29	. .	. .	'22	'20	'10	. .	. .	'28	'09	. .	. .	. .
'36	'37	'33	'38	'26	'41	'43	'33	'31	'02	'22	'26	'34	. .	'10	'20	'40	'14	. .	. .	'40	'28	. .	. .	. .
. .	. .	. .	. .	. .	'01	'06	. .	. .	'25	'20	. .	'11	'37	'50	. .	'20	. .	. .	. .	'05	'05	1'20	. .	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	'02	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	'70
. .	'40	. .	. .	. .	. .	. .	. .	'66	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	'70
'60	'17	. .	'56	'65	'40	'22	'53	. .	'15	1'60	'57	'30	'26	'15	'16	'20	'07	. .	. .	'20	'19	'09	. .	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	'12	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
'97	1'89	2'61	2'00	1'35	1'85	1'88	2'16	1'63	'30	'46	1'15	'58	1'15	'54	'59	'30	'61	. .	. .	'53	'74	'07	. .	'10
. .	. .	. .	. .	. .	. .	. .	. .	. .	'03	'45	'16	'10	. .	. .	1'00	'30	. .	. .	. .	'22	'35	. .	. .	'10
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7'63	8'87	9'06	10'05	8'11	7'43	7'78	8'63	8'71	4'91	9'03	7'88	6'51	8'13	7'13	8'18	7'70	5'03	8'50	4'90	6'47	4'09	8'30	6'19	3'80

T. F. T.

PRECIPITATION FOR NOVEMBER, 1889.

	Harrisburg.	Selins Grove.	Lancaster.	Le Roy.	Eagles Mere.	Myerstown.	Wysox.	Catawissa.	Girardville.	Wilkes-Barre.	South Eaton.	Drifton.	Reading.	Pottstown.	West Chester.	Coatesville.	Kennett Square.	Dyberry.	Honesdale.	Quakertown.	
.	.02	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	.03	.01	. .	. .	. .	. .	.
20	.04	.21	.05	.04	.95	.20	.26	.40	.84	. .	. .	.60	.34	.05	.66	.03	.05	.22	1.00	.71	.
46	.62	.60	.48	.38	.44	.61	.09	.90	1.27	1.29	1.12	1.04	.57	.60	.68	.59	.67	1.59	.46	.81	.
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10	.30	.30	.39	.10	1.03	.47	.25	.55	.56	.11	.12	.82	.37	.40	.47	.46	.40	.11	.22	.34	.
05	1.16	1.00	1.58	.20	.82	1.97	. .	.90	1.11	.61	.36	.40	1.96	2.30	1.58	1.66	1.74	.58	.58	2.59	1.
.	. .	.15	. .	.04	. .	.09	. .	. .	.09	. .	. .	.06	.05	. .	.08	. .	.16	. .	. .	.04	
16	.20	.10	.17	.17	.36	.22	.19	.09	.13	.11	.08	.10	.15	.10	.16	.08	. .	.20	.09	.13	.
.	. .	. .	. .	. .	.09	. .	. .	. .	. .	. .	. .	. .	. .	. .	.04	. .	. .	. .	. .	.02	.
04	.66	.51	1.01	.35	.23	.63	.32	.53	1.23	.51	.26	.82	.95	1.20	1.01	1.14	1.05	.44	.45	1.01	.
.	.02	. .	. .	.11	. .	. .	.07	. .	. .	.07	.17	. .	. .	. .	.06	. .	. .	.07	. .	.01	.
.	. .	. .	. .	.05	. .	. .	. .	. .	.05	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	.
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.	.04	. .	.12	. .	. .	.04	.09	.10	.08	. .	. .	. .	.04	. .	. .	.01	. .	. .	. .	. .	.
56	.56	.60	.96	.45	1.03	1.09	1.12	.35	1.10	.26	. .	.62	.68	.65	.97	.81	.30	. .	.05	.36	.
96	1.26	3.56	2.33	2.38	1.64	2.26	.89	1.10	1.14	1.10	1.20	.84	2.30	1.50	2.02	1.60	2.31	.46	.50	.96	1.
06	.10	.25	.10	.01	.86	.05	.10	.34	.16	.03	.12	.07	.09	.10	.08	.15	.12	.08	.07	.16	.
10	.20	.65	.26	.06	.58	.27	.41	.30	.36	.03	.24	. .	.42	.40	.40	.33	.35	.34	.30	.37	.
26	.06	.02	. .	.42	. .	. .	.14	.02	.03	.38	.11	. .	. .	. .	.08	.03	. .	.16	.05	. .	.
08	.01	. .	. .	.05	. .	. .	. .	. .	. .	.40	.01	. .	. .	. .	. .	. .	. .	. .	. .	. .	.
02	. .	. .	. .	.01	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	.04	. .	.
.	.20	.22	.52	. .	.08	.41	. .	.17	.28	.09	.08	.46	.72	.65	.37	.38	.20	.05	.02	.61	.
.	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	.74	. .	. .	. .	. .	. .	. .	. .	. .	.
54	.60	.56	.37	.20	.47	1.22	.97	.85	1.36	.25	.54	.77	.24	.60	.75	.59	.62	.35	1.10	.77	1.
68	.34	.40	.68	.74	.69	.46	.08	.35	.37	1.15	1.11	.03	. .	.60	.45	.73	.75	1.05	.37	.58	.
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97	6.59	9.13	9.02	5.80	9.27	9.99	5.02	6.95	10.16	6.39	5.52	7.39	8.88	9.15	9.91	8.60	8.92	5.70	5.31	8.88	6.

14th, 15th, 23d, 26th, 30th; Lancaster, 4th, 7th, 16th, 17th, 24th, 30th; New Castle, 6th, 16th, 17th, 26th, 29th, 30th; Myerstown, 4th, 6th, 7th, 16th, 17th, 24th, 26th; Annville, 6th, 7th, 16th, 26th, 27th, 30th; Greenville, 4th, 5th, 7th, 17th; Bethlehem, 4th, 6th, 7th, 16th, 17th, 26th, 30th; New Bloomfield, 7th; Girardville, 5th, 6th, 7th, 8th, 12th, 16th, 17th, 18th, 20th, 23d, 24th, 26th, 27th, 28th, 29th; Selins Grove, 4th, 7th, 16th, 17th, 24th, 26th, 30th; Eagles Mere, 4th, 5th, 7th, 17th; Wellsboro, 4th, 7th, 11th, 12th, 15th, 16th, 17th, 23d, 24th, 26th, 27th, 28th, 29th, 30th; Columbus, 4th, 5th, 6th, 7th, 14th, 15th, 16th, 17th, 24th, 26th, 27th, 28th, 29th, 30th; Dyberry, 4th, 5th, 6th, 7th, 12th, 15th, 16th, 17th, 18th, 24th, 26th, 27th, 29th, 30th; South Eaton, 4th, 7th, 15th, 16th, 17th, 18th, 24th, 26th, 27th, 29th, 30th; York, 4th, 6th, 7th, 11th, 16th, 17th, 24th, 26th, 27th; Lewistown, 16th, 17th, 24th, 26th; Tipton, 4th, 5th, 7th, 11th, 16th, 24th, 26th; Greensburg, 4th, 5th, 6th, 7th, 16th; Somerset, 5th.

Sleet.—Charlesville, 26th; Blue Knob, 14th, 27th; Hollidaysburg, 15th; Grampian Hills, 18th; Wellsboro, 27th; Dyberry, 27th; South Eaton, 27th; Greensburg, 26th.

Coronæ.—Charlesville, 11th; Le Roy, 29th; Indiana, 1st, 4th; Eagles Mere, 4th; Dyberry, 7th.

Solar Halos.—Le Roy, 26th; Carlisle, 1st, 3d, 6th, 10th.

Lunar Halos.—Charlesville, 10th; Wysox, 30th; Rimersburg, 1st, 12th; Lancaster, 1st; Selins Grove, 29th; Eagles Mere, 1st; South Eaton, 4th; Greensburg, 4th; Somerset, 1st.

Meteors.—Quakertown, 10th, 14th; State College, 15th; New Castle, 6th; Centre Valley, 24th.

WEATHER FORECASTS.

Percentage of local verifications of weather and temperature signals as reported by displaymen for November, 1889:

Weather, 89 per cent.

Temperature, 86 per cent.

TEMPERATURE AND WEATHER SIGNAL DISPLAY STATIONS.

Displayman.	*Station.*
U. S. Signal Office,	Philadelphia.
Wanamaker & Brown,	"
Pennsylvania Railroad Company,	"
Continental Brewing Company,	"
Samuel Simpson,	"
B. T. Babbitt,	"
Western Meat Company,	"
Neptune Laundry,	"
Chester Oil Company,	Chester.
C. W. Burkhart,	Shoemakerville.
A. N. Lindenmuth,	Allentown.
C. B. Whitehead,	Bradford.

Displayman.	*Station.*
Capt. Geo. R. Guss,	West Chester.
Werner & Son,	Emporium.
C. E. Lenhart,	Latrobe.
Thomas F. Sloan,	McConnellsburg.
J. H. Fulmer,	Muncy.
W. T. Butz,	New Castle.
S. W. Morrison,	Oxford.
Capt. A. Goldsmith,	Quakertown.
J. L. Morrison,	Sharon.
Wm. A. Engel,	Shenandoah.
Wm. Schrock,	Somerset.
Postmaster,	Meadville.
Frank Ross,	Oil City.
Lerch & Rice,	Bethlehem.
John W. Aitken,	Carbondale.
Signal Office,	Erie.
J. R. Raynsford,	Montrose.
E. P. Wilbur & Co.,	South Bethlehem.
Agricultural Experiment Station,	State College.
Signal Office,	Pittsburgh.
E. H. Baker,	Williamsport.
New Era,	Lancaster.
State Normal School,	Clarion.
Clarion Collegiate Institute,	Rimersburg.
E. S. Chase,	Eagles Mere.
Thiel College,	Greenville.
D. G. Hurley,	Altoona.
J. E. Forsythe,	Butler.
James H. Fones,	Tionesta.
Wister, Hacker & Savage,	Germantown.
W. J. Thompson & Co.,	Clifton Heights.
Steward M. Dreher,	Stroudsburg.
State Normal School,	Millersville.
E. C. Wagner,	Girardville.
Hartford P. Brown,	Rochester.
L. H. Grenewald,	York.
J. E. Pague,	Carlisle.
C. L. Peck,	Coudersport.
H. D. Miller,	Drifton.
Smith Curtis,	Beaver.
M. Tannehill,	Confluence.
S. C. Burkholder,	Pollock.
Robt. M. Graham,	Catawissa.
Henry F. Bitner,	Millersville.
A. J. Edelman,	Pottstown.
A. M. Wildman,	Langhorne.

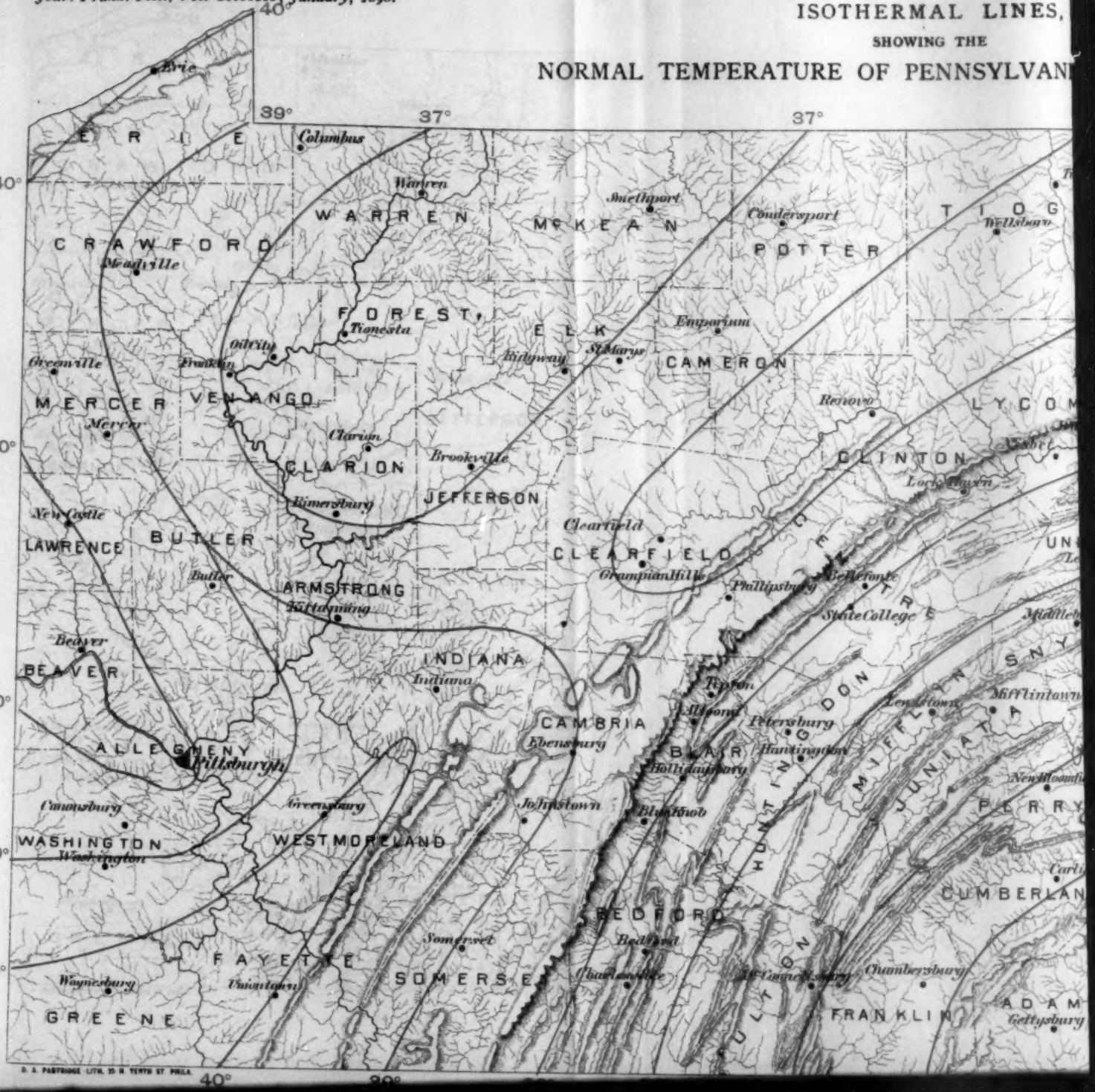
Displayman.	*Station.*
N. E. Graham,	East Brady.
B. F. Gilmore,	Chambersburg.
Frank M. Morrow,	Altoona.
A. Simon's Sons,	Lock Haven.
E. W. McArthurs,	Meadville.
J. K. M. McGovern,	Lock No. 4.
Raftsman's Journal,	Clearfield.
W. S. Ravenscroft,	Hyndman.
R. C. Schmidt & Co.,	Belle Vernon.
Jesse R. Brown,	Lehmasters.
H. W. Mullen,	Centre Valley.
Mayer Bros.,	Bloomsburg.
E. C. Lorentz,	Johnstown.
W. M. James,	Ashland.
Miller & Allison,	Punxsutawney.
Dr. A. L. Runion,	Canonsburg.
E. J. Sellers,	Kutztown.
T. F. Heebner,	Scranton.
H. J. Fosnot,	Lewistown.

40°
40°
40°
39°
40°

ISOTHERMAL LINES,

SHOWING THE

NORMAL TEMPERATURE OF PENNSYLVANI



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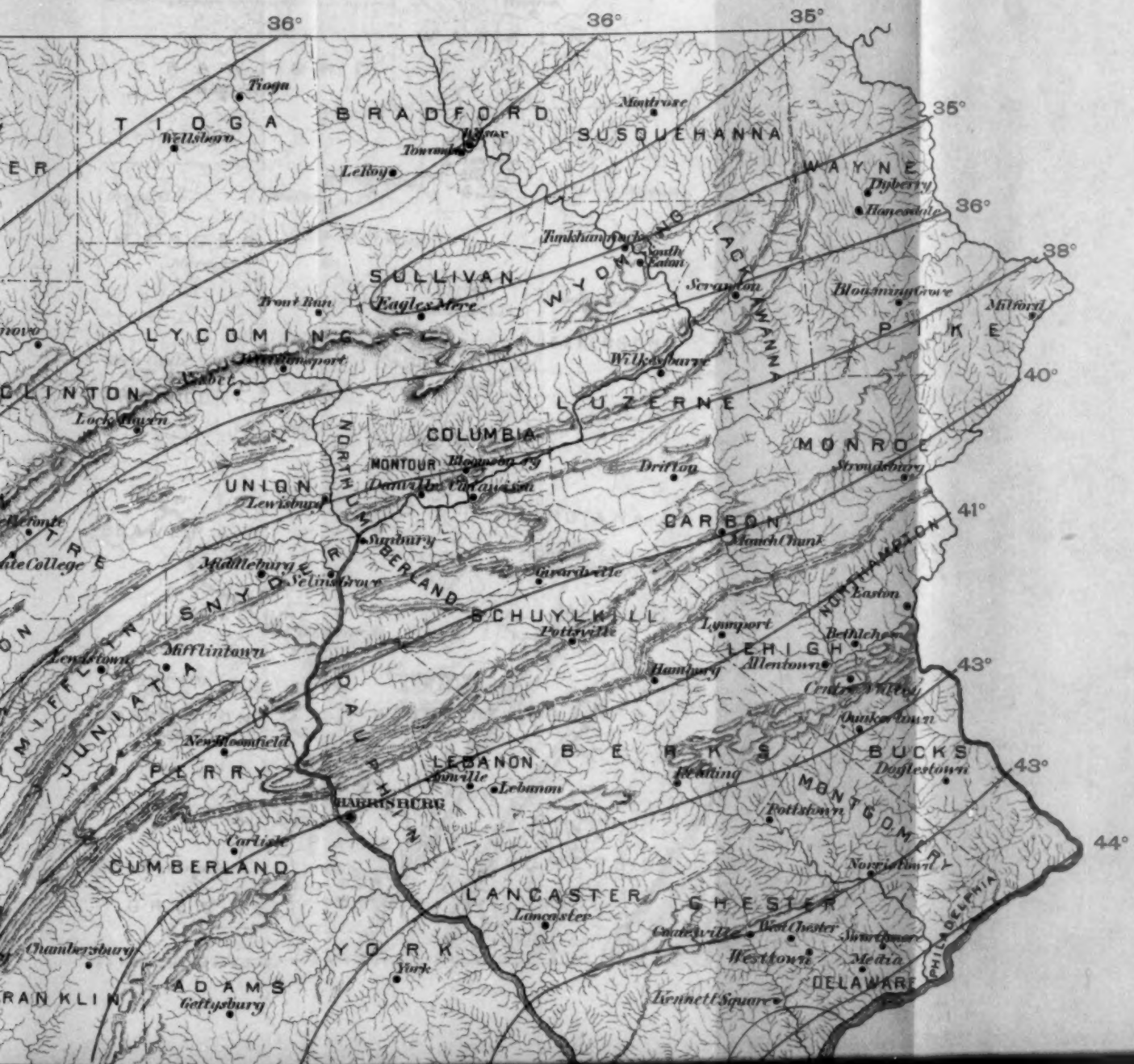
NORMAL TEMPERATURE OF PE

State Weather Service.

THERMAL LINES,

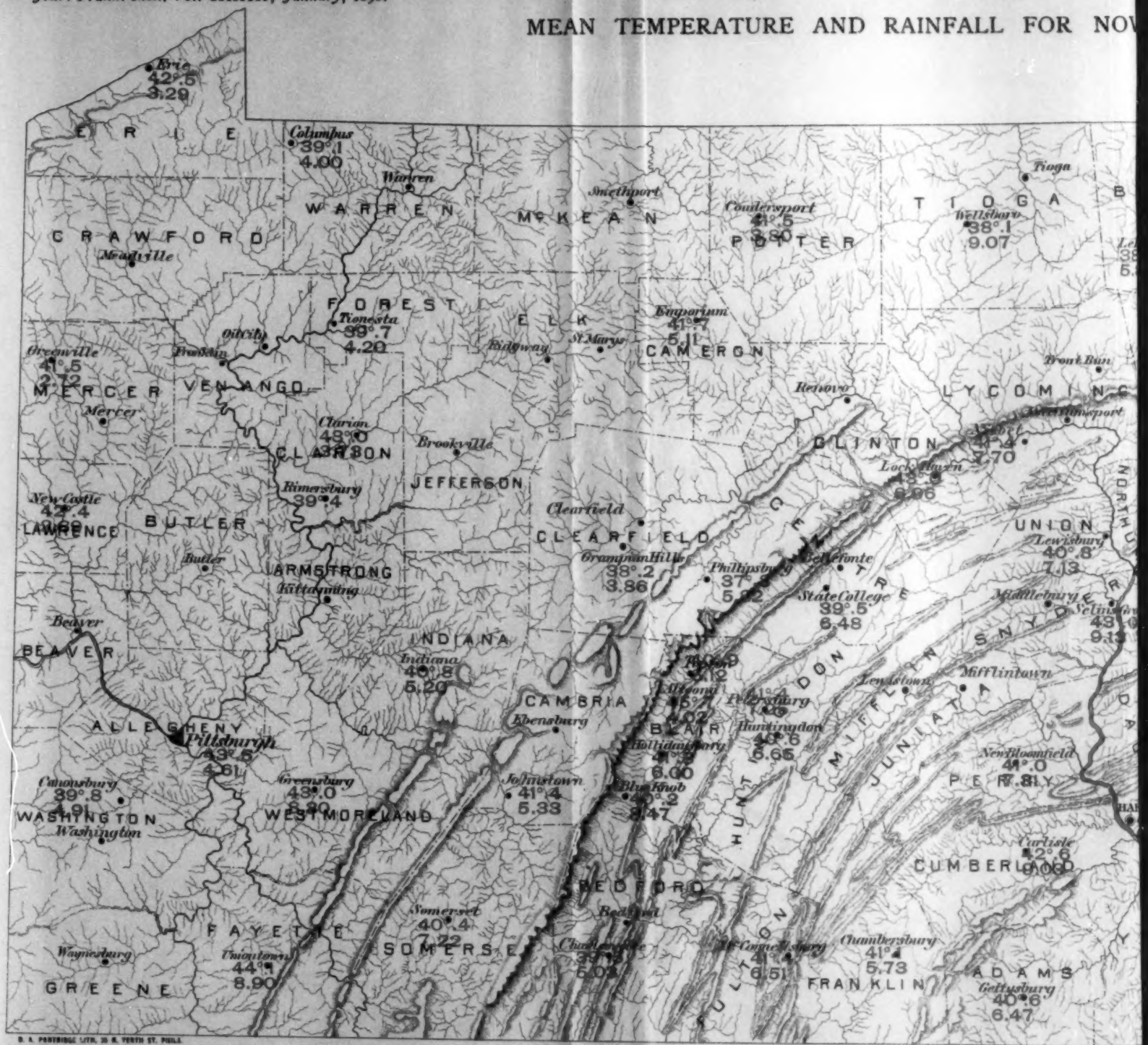
SHOWING THE

E OF PENNSYLVANIA FOR NOVEMBER.



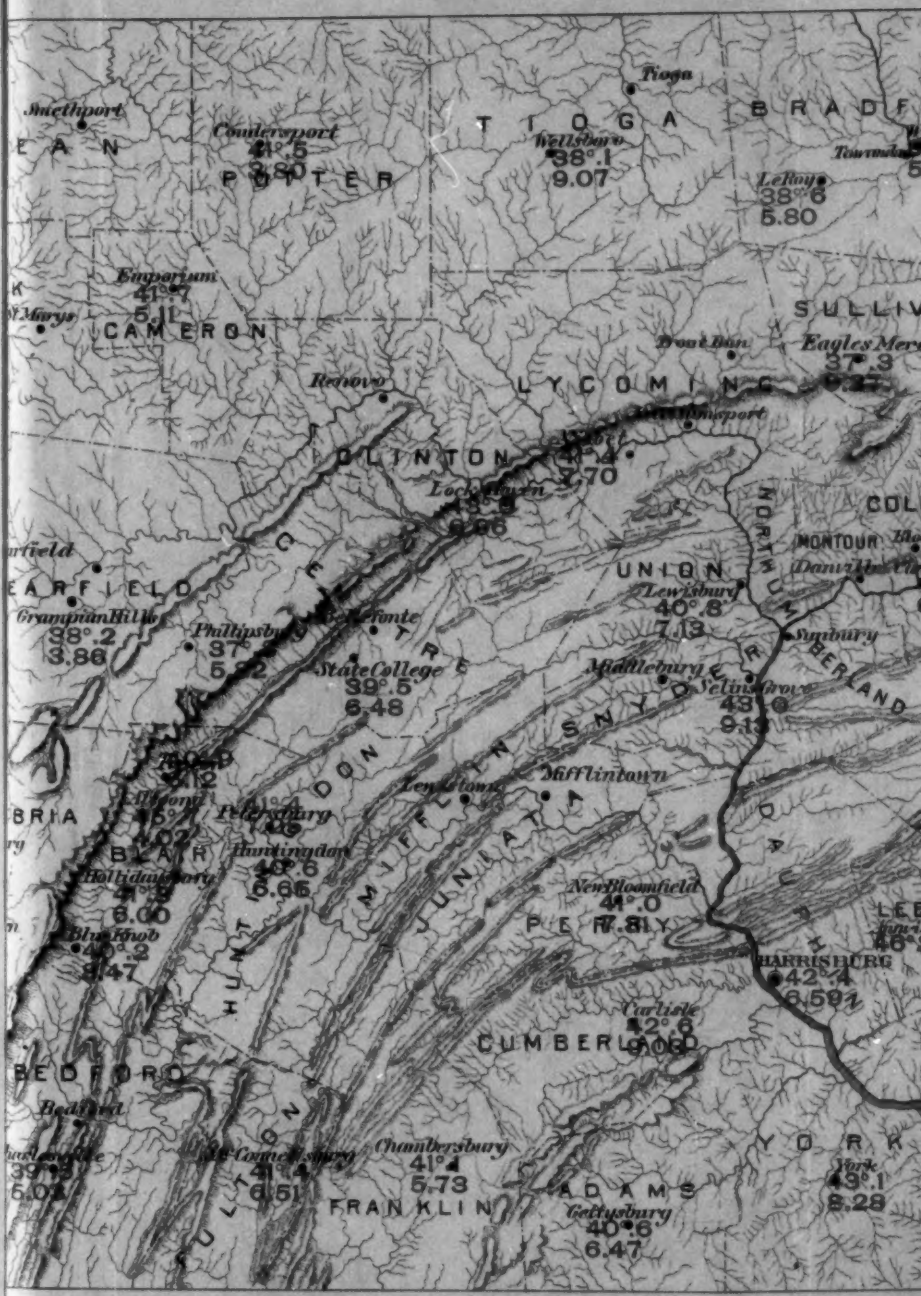
ate Weather Service.

MEAN TEMPERATURE AND RAINFALL FOR NOV



P. A. PORTRIDGE LITH. 20 S. TENTH ST. PHILA.

N TEMPERATURE AND RAINFALL FOR NOVEMBER,



EMBER, 1889.

RADFORD
SUSQUEHANNA
WAYNE
SULLIVAN
WYOMING
LACKAWANNA
PIKE
LUZERNE
COLUMBIA
MONROE
CARBON
NORTHAMPTON
SCHUYLKILL
LEBANON
BERKS
MONTGOMERY
LANCASTER
CHESTER
DELAWARE
Montrose
Towanda
5.02
Hawley
5.10
Honesdale
41°.2
5.31
Eagles Mere
37.3
Scranton
42°.7
5.52
Bloomingrove
Milford
Wilkesbarre
42.0
8.20
Bloomsburg
Danville
Orangeville
41°.4
10.16
Pottsville
Drifton
40°.1
7.39
Mauch Chunk
42°.1
8.18
Easton
Lumport
42°.4
8.56
Bethlehem
Allentown
Hamburg
Quakertown
42°.4
8.89
Doylestown
Reading
42°.8
8.88
Lebanon
41°.5
9.99
Pottstown
46°.0
9.50
Norristown
Lancaster
43°.2
9.02
Chadsville
42.7
8.60
Westtown
44°.0
8.13
Media
Bennett Square
44°.0
8.92
York
43°.1
8.28

Smethport
E A N
K
St Marys
Milford
K E
arfield
E A R F I
Grampian H
38°.2
3.86
BRIA
Bn
Holl
A K S
Blunk
BEDF
Bedford
47.6
6.86
39.12
5.02

PENNSYLVANIA STATE WEATHER SERVICE.

MONTHLY WEATHER REVIEW

FOR DECEMBER, 1889.

Prepared under the Direction of the Committee on Meteorology of the FRANKLIN INSTITUTE.

HALL OF THE FRANKLIN INSTITUTE.

PHILADELPHIA, December 31, 1889.

TEMPERATURE.

The mean temperature for December 1889, determined from 64 stations gives a mean or average temperature of 39°·3, which is about 9° in excess of the normal, and as compared with Philadelphia temperatures for the past 100 years and over, it was the warmest December on record.

The greatest departures were in the western part of the State where the mean temperature for the month averaged 11° above the normal. In the eastern portion it was about 7° above.

There was a complete absence of the low temperatures that usually occur in December, and the maximum temperatures were decidedly higher.

The highest temperatures reported were Centre Valley, 73; Lewistown, 70; Erie, 70; Waynesburg, 70 and Coatesville, 68°·5.

The lowest were Le Roy, zero; Eagles Mere, zero; Somerset, 6°; Wysox, Grampian Hills, Wellsboro, Columbus, Dyberry and Honesdale each 8°. The lowest temperatures occurred on the 4th, and the highest during the 25th.

Total excess in temperature during December at Philadelphia, 279°.

Total excess in temperature during December at Pittsburgh, 387°.

Total excess in temperature since January 1st at Philadelphia, 613°.

Total excess in temperature since January 1st at Pittsburgh, 568°.

BAROMETER.

The mean pressure for the month, 30·15, is about ·05 higher than the above. The highest occurred on the 31st, and the lowest on the 26th.

PRECIPITATION.

The total precipitation for the month 2·77 inches is about 2 tenths less than the average. There was a slight excess in the western part of the State and a deficiency in the eastern. The greatest totals were Columbus 5·05; Grampian Hills, 4·67; Johnstown, 4·62 Tipton, 4·49; and Somerset, 4·29 inches. The least were Philadelphia, 0·85; Germantown, 0·91 and Swarthmore 1 05 inches.

The only snow that occurred was in the northeastern part of the State. The following are the greatest totals. Dyberry, 7 inches; Honesdale 6 inches; South Eaton, 6 inches; Eagles Mere, 5 inches; Wellsboro, 5 inches and Catawissa, 4 inches. Rains were of frequent occurrence but light.

WIND AND WEATHER.

The prevailing wind was from the west. No severe gales passed over the State.

The month will be memorable from having been the warmest December on record.

Average Number.—Rainy days, 12; clear days, 11; fair days, 9; cloudy days, 11.

MISCELLANEOUS PHENOMENA.

Thunder-storms.—Blue Knob, 11th, 14th; Tipton, 14th, 26th; Johnstown, 11th; Emporium, 11th; Mauch Chunk, 26th; State College, 26th; Phillipsburg, 14th; Clarion, 26th; Grampian Hills, 26th; Lock Haven, 22d, 26th; Catawissa, 26th; Centre Valley, 26th; Lynnport, 26th; Wilkes-Barre, 26th; Nisbet, 26th; Lewistown, 26th; New Bloomfield, 25th; Girardville, 26th; Selins Grove, 26th; Wellsboro, 21st, 26th; Lewisburg, 26th; Columbus, 22d, 26th; Canonsburg, 26th.

Hail.—Blue Knob, 11th, 14th, 26th; Forks of Neshaminy, 14th; Johnstown, 11th; Emporium, 5th, 26th; Mauch Chunk, 14th, 26th; Grampian Hills, 26th; Catawissa, 5th; Petersburg, 14th; Nisbet, 14th, 26th; Bethlehem, 5th; Girardville, 26th; Wellsboro, 5th, 14th; South Eaton, 14th; Dyberry, 5th.

Snow.—Blue Knob, 3d, 4th, 15th, 30th; Hollidaysburg, 15th; Wysox, 3d, 14th; Le Roy, 3d, 4th; Forks of Neshaminy, 3d; Quakertown, 3d, 4th, 14th; Emporium, 3d, 5th, 14th; Mauch Chunk, 3d, 5th, 14th; State College, 3d; Coatesville, 3d; Westtown, 3d, 14th; Catawissa, 3d, 14th; Chambersburg, 15th; Petersburg, 3d,; Myerstown, 3d, 4th; Annville, 15th; Centre Valley, 3d, 14th; Lynnport, 14th; Wilkes-Barre, 14th; Nisbet, 14th; Greenville, 4th, 15th, 30th; Lewistown, 15th; Bethlehem, 3d, 5th, 14th; Girardville, 14th; Selins Grove, 3d, 14th; Eagles Mere, 3d, 14th; Wellsboro, 3d, 14th; Lewisburg, 3d, 14th, 15th; Dyberry, 5th, 14th; South Eaton, 14th; Coopersburg, 2d.

Frost.—Gettysburg, 1st, 2d, 3d, 8th, 24th, 28th, 29th, 31st; Charlesville, 16th, 31st; Blue Knob, 12th, 31st; Hollidaysburg, 7th, 9th, 10th, 12th, 16th; Tipton, 1st, 4th, 6th, 7th, 10th, 12th, 16th, 23d, 24th, 31st; Forks of Neshaminy, 1st, 2d, 7th, 8th, 10th, 16th, 22d, 24th, 28th, 29th, 31st, Quakertown, 1st, 2d, 4th, 6th, 7th, 8th, 10th, 21st, 23d, 24th, 28th, 31st;

Monthly Summary of Reports by Voluntary Observers of the Pennsylvania State Weather S

County.	Station.	Elevation above Sea Level (feet).	Barometer Reduced to Sea Level.			Temperature.											Relative Humidity.	Dew Point.	Prec	
							Maximum.		Minimum.				Daily Range.							
			Mean.	Highest.	Lowest.	Mean.	Highest.	Date.	Lowest.	Date.	Mean of Maximum.	Mean of Minimum.	Mean.	Greatest.	Date.	Least.	Date.			Total Inches.	Total Snowfall During Month.
ams,[1]	Gettysburg,	624	. .	. . .	. . .	39·6	69·0	23	13·0	4	49·4	29·8	19·6	36·0	2	4·0	18	. . .	. . .	2·01	. .
gheny,[1]	Pittsburgh,	847	30·148	30·665	29·588	45·6	67·0	29	22·0	1	53·5	37·8	15·7	26·0	29	7·0	30	75·2	37·4	3·07	. .
ford,	Charlesville (26 days),	1,300	. . .	. . .	. . .	39·7	66·0	20	12·0	1	50·0	29·4	20·6	40·0	7	5·0	18	78·2	33·7	1·63	. .
rks,[1]	Reading,	304	30·180	30·707	29·850	39·4	67·0	25	15·0	5	48·6	30·4	18·2	29·0	24	5·0	18	92·8	36·1	2·35	. .
ir,[2]	Altoona,	1,181	. . .	. . .	. . .	44·1	65·0	21	21·0	2	54·7	35·6	17·1	29·0	27	5·0	18	68·7	34·0	3·42	. .
ir,	Blue Knob,	2,100	. . .	. . .	. . .	37·9	60·0	20	13·0	31	43·7	31·0	12·7	25·0	7	5·0	18	. . .	. . .	. . .	. .
ir,	Hollidaysburg,	947	. . .	. . .	. . .	41·0	64·0	25	10·0	1	50·5	28·4	22·1	38·0	7	8·0	18	73·5	33·0	3·36	. .
ir,	Tipton,	915	. . .	. . .	. . .	39·4	65·0	20, 25	13·0	4	48·0	32·0	16·0	34·0	7	3·0	17	. . .	. . .	4·49	. .
dford,	Wysox,	718	30·155	30·796	29·558	35·7	62·5	20	8·0	4	44·7	25·7	19·0	33·0	20	5·0	17	78·9	29·8	2·51	3·50
dford,	Le Roy,	1,400	. . .	. . .	. . .	34·5	58·0	20	0	4	41·5	28·7	12·8	30·0	3	4·0	18	. . .	. . .	2·45	4·40
ks,	Forks of Neshaminy,	. . .	. . .	. . .	. . .	40·2	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	1·65	. .
ks,	Quakertown,	536	30·160	30·870	29·430	37·9	67·0	25	11·0	4	48·8	28·3	20·5	30·5	24	5·7	18	77·3	32·0	2·43	1·00
mbria,	Johnstown,	1,184	30·182	30·780	29·630	42·6	67·0	20, 25	10·0	1	54·1	33·4	20·7	36·0	7	9·0	15	74·9	35·0	4·62	. .
meron,	Emporium,	1,030	. . .	. . .	. . .	38·6	62·0	20	12·0	4	46·6	27·5	19·1	31·0	7	6·0	17	. . .	. . .	4·64	. .
mbon,[1]	Mauch Chunk,	550	. . .	. . .	. . .	37·6	60·0	9	14·5	4	47·4	27·8	19·6	32·5	2	6·0	18	. . .	. . .	3·58	3·00
mbre,	State College— Agricultural Experiment Station,	1,191	30·121	30·750	29·492	38·9	64·0	20, 26	9·0	4	47·4	30·3	17·1	32·0	30	3·0	17	78·0	32·1	3·29	. .
mbre,	Phillipsburg,	1,350	. . .	. . .	. . .	37·5	63·0	20, 25	9·0	4	51·2	26·5	24·7	39·0	4	6·0	17	. . .	. . .	3·68	. .
ester,	West Chester,	435	30·156	30·830	29·444	41·0	67·0	25	16·0	4	50·1	32·9	17·2	25·0	25	5·0	18	. . .	. . .	1·95	. .
ester,	Coatesville,	380	. . .	. . .	. . .	39·1	69·5	26	17·0	5	52·0	29·4	22·6	36·0	13	3·5	18	. . .	. . .	1·60	. .
ester,[1]	Kennett Square,	275	. . .	. . .	. . .	38·8	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	.49	. .
ester,[1]	Westtown,	350	30·017	30·687	29·292	40·9	66·0	26	18·0	4, 5	49·4	33·0	16·4	24·6	13	4·5	18	. . .	. . .	1·23	.50
rion,	Rimersburg,	1,500	. . .	. . .	. . .	40·1	58·0	20	12·0	4	45·3	33·4	11·9	22·0	20	2·0	31	. . .	. . .	. . .	. .
rion,	Clarion— State Normal School,	1,530	. . .	. . .	. . .	39·8	63·0	29	10·0	4	48·2	28·8	19·4	32·0	27	6·0	15	76·7	33·5	3·61	. .
rfield,	Grampian Hills,	1,450	. . .	. . .	. . .	36·8	60·0	20, 29	8·0	1	43·0	30·0	15·0	28·0	24	2·0	17	. . .	. . .	4·67	. .
ton,	Lock Haven,	560	. . .	. . .	. . .	37·9	66·0	25	14·0	4	46·6	28·6	18·0	30·0	13	5·0	16	. . .	. . .	4·19	. .
mbia,	Catawissa,	491	. . .	. . .	. . .	38·8	64·0	25	17·0	4	45·6	32·0	13·6	23·0	20	5·0	14	. . .	. . .	3·41	4·00
berland,	Carlisle,	480	. . .	. . .	. . .	39·6	69·5	25	15·5	4	49·6	30·3	19·3	37·0	2	5·0	18	84·5	34·5	2·44	. .
phin,[1]	Harrisburg,	361	30·200	30·850	29·600	40·0	66·0	25	14·0	4	47·7	32·5	15·2	26·0	2	5·0	18	76·9	32·3	2·11	. .
aware,	Swarthmore— Swarthmore College,	190	30·163	30·803	29·543	41·4	67·0	26	18·0	4	50·2	31·9	18·3	28·5	25	4·2	18	77·8	34·5	1·05	. .
e,[1]	Erie,	681	30·100	30·707	29·501	41·0	70·0	29	12·0	4	48·9	32·5	16·4	34·0	29	6·0	30	80·0	33·0	4·03	. .
yette,	Uniontown,	1,000	30·212	30·582	29·701	46·0	67·0	29	14·0	1	58·9	37·3	15·6	32·0	24	4·0	22	81·0	40·0	2·76	. .
rest,	Tionesta,	1,057	. .	. .	. . .	38·5	66·0	27	11·0	4	50·0	31·4	18·6	36·0	27	4·0	17	. . .	. . .	. . .	. .
nklin,[1]	Chambersburg— Wilson Female College (29 days),	618	30·211	30·831	29·633	37·9	64·0	26, 27	15·0	1, 4	50·2	28·3	21·9	37·0	2	7·0	18	84·6	33·2	2·03	. .
ene,	McConnellsburg,	875	. . .	. . .	. . .	41·1	67·0	25	13·0	1	52·8	31·0	21·8	40·0	2	6·0	18	74·7	33·4	2·44	. .
ntingdon,[1]	Waynesburg,	739	. . .	. . .	. . .	42·8	70·0	25	. . .	. . .	55·6	30·0	25·6	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. .
ntingdon,	Huntingdon— The Normal College,	650	. . .	. . .	. . .	39·9	68·0	20, 21	12·0	4	52·1	27·7	24·4	46·0	26	10·0	18	. . .	. . .	3·14	. .
iana,	Petersburg,	700	. . .	. . .	. . .	39·5	69·0	20	12·0	4	49·5	30·5	19·0	38·0	2	3·0	30	. . .	. . .	2·31	. .
caster,	Indiana— State Normal School,	1,350	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. .
caster,	Lancaster,	411	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. .
rence,	New Castle,	932	. . .	. . .	. . .	42·8	66·0	29	12·0	1	50·0	29·5	20·5	36·0	30	10·0	9	. . .	. . .	3·64	. .
anon,	Myerstown,	474	30·213	30·731	29·608	37·7	67·5	23	16·5	5	48·6	29·3	19·3	29·2	13	3·2	18	86·7	33·7	2·20	. .
anon,	Annville— Lebanon Valley College,	339	. . .	. . .	. . .	41·6	68·0	25	20·0	4	. . .	. . .	. . .	. . .	. . .	. . .	. . .	76·2	33·8	. . .	. .
igh,	Centre Valley,	348	. . .	. . .	. . .	40·7	73·0	25	19·0	4	54·6	33·1	19·5	34·0	24	5·0	15	. . .	. . .	2·30	. .
igh,	Coopersburg,	520	. . .	. . .	. . .	39·3	69·0	25	13·5	4	50·7	31·9	18·8	40·0	25	7·0	14	. . .	. . .	2·82	.30
igh,[1]	Lynnport,	350	. . .	. . .	. . .	37·7	65·0	25	14·0	5	46·9	28·5	18·4	40·0	24	3·0	4	. . .	. . .	. . .	. .
erne,	Drifton— Drifton Hospital,	1,655	. . .	. . .	. . .	36·3	61·0	24	10·0	4	45·8	28·8	17·0	31·0	24	5·0	6	. . .	. . .	2·11	3·50
rne,[1]	Wilkes-Barre,	575	. . .	. . .	. . .	33·0	67·0	25	15·0	4	48·0	30·0	18·0	30·0	21	7·0	19	. . .	. . .	2·72	. .
ming,[1]	Nisbet,	550	. . .	. . .	. . .	36·5	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	4·00	. .
cer,[1]	Greenville— Thiel College,	1,000	30·091	30·644	29·495	39·5	64·7	29	11·4	1	49·9	29·2	20·7	30·0	27	5·1	23	89·2	33·8	3·03	. .
lin,	Lewistown,	500	. . .	. . .	. . .	41·0	70·0	25	14·5	4	50·5	30·2	20·3	38·0	2	5·0	17	77·1	33·3	2·35	. .
tgomery,	Pottstown,	150	. . .	. . .	. . .	42·0	69·0	25	18·0	4	51·0	33·0	18·0	31·0	24	4·0	18	79·0	32·0	2·03	. .
thampton,	Bethlehem,	360	30·127	30·813	29·503	40·0	68·0	25	12·0	4	48·0	31·0	17·0	29·0	26	5·0	18	78·0	36·0	1·66	. .
ry,	New Bloomfield,	400	. . .	. . .	. . .	39·0	68·0	25	13·0	4	49·4	29·0	20·4	35·0	2	4·0	18	. . .	. . .	2·24	. .
adelphia,[1]	Philadelphia— Signal Office,	117	30·193	30·881	29·604	43·6	68·0	26	16·0	4	51·0	36·1	14·9	24·0	25	5·0	14	71·8	32·7	.85	. .
ter,	Coudersport,	1,670	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. .
ylkill,	Girardville,	1,000	30·170	30·768	29·620	38·3	64·0	25	16·0	4	47·4	28·6	18·8	33·0	21	6·0	18	. . .	. . .	3·31	1·75
der,	Selins Grove,	445	. . .	. . .	. . .	36·8	69·0	25	21·0	31	49·4	31·9	17·5	37·0	25	0	4	79·6	32·5	2·66	. .
rset,	Somerset,	2,250	. . .	. . .	. . .	41·7	63·0	29	6·0	1	51·2	31·4	19·8	34·0	1	2·0	16	81·2	36·0	4·29	. .
van,	Eagles Mere,	2,000	30·252	30·849	29·698	33·1	51·0	19, 20	0	4	38·8	26·2	12·6	30·0	4	2·0	23	76·7	26·8	3·28	5·25
ga,	Wellsboro,	1,327	30·196	30·742	29·616	34·5	64·0	25	8·0	4	42·7	28·4	14·3	25·0	1	8·0	29	82·4	29·5	3·93	5·00
on,[1]	Lewisburg,	450	. . .	. . .	. . .	37·8	64·0	25	14·0	4	46·5	29·2	17·3	30·0	13	5·0	17	. . .	. . .	2·67	1·20
ren,	Columbus,	1,410	. . .	. . .	. . .	37·3	60·0	29	8·0	4	44·8	29·8	15·0	30·0	29	2·0	30	. . .	. . .	5·09	. .
shington,	Canonsburg,	950	30·149	30·658	29·731	43·4	68·0	17	11·0	1	52·7	34·6	21·1	34·0	24	9·0	15	77·7	36·7	3·30	. .
yne,	Dyberry,	1,100	. . .	. . .	. . .	33·2	61·0	25	8·0	4	44·3	24·0	20·3	38·0	20	1·0	18	. . .	. . .	2·91	7·00
yne,	Honesdale,	1,000	. . .	. . .	. . .	35·5	61·0	25	8·0	4	42·6	28·4	14·2	28·0	20	4·0	18	71·5	31·5	3·53	6·00
moreland,	Greensburg,	1,175	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. .
mling,[1]	South Eaton	660	. . .	. . .	. . .	34·5	67·0	25	12·0	4	46·0	27·6	18·4	29·0	20	4·0	17	. . .	. . .	2·32	5·50
k,[1]	York,	385	30·189	30·874	29·536	40·6	68·0	25	16·5	4, 5	52·3	31·9	20·4	34·5	27	5·0	15	73·0	32·0	1·09	. .

[1] Observations taken at 8 A. M. and 8 P. M. [2] Observations taken at 12 Noon.

VOLUNTARY OBSERVERS OF THE PENNSYLVANIA STATE WEATHER SERVICE FOR DECEMBER, 18

Date.	Temperature. Mean of Maximum.	Mean of Minimum.	Daily Range. Mean.	Greatest.	Date.	Least.	Date.	Relative Humidity.	Dew Point.	Precipitation. Total Inches.	Total Snowfall During Month.	Depth of Snow on Ground at End of Month.	Number of Days Rainfall.	Number of D. Clear.	Fair.
4	49·4	29·8	19·6	36·0	2	4·0	18	. . .	. . .	2·01	. . .	. . .	11	13	2
1	33·5	37·8	15·7	26·0	29	7·0	30	75·2	37·4	3·07	. . .	. . .	16	6	14
1	30·0	29·4	20·6	40·0	7	5·0	28	78·3	33·7	1·63	. . .	. . .	6	11	12
5	48·6	30·4	18·2	29·0	24	5·0	18	92·8	36·1	2·35	. . .	. . .	9	13	12
2	54·7	35·6	17·1	29·0	27	5·0	18	68·7	34·0	3·42	. . .	. . .	14	. . .	. . .
1	43·7	31·0	12·7	25·0	7	5·0	18	. . .	. . .	. . .	. . .	. . .	15	13	9
1	30·5	28·4	22·1	38·0	7	8·0	18	73·5	33·0	3·36	. . .	. . .	15	14	8
4	48·0	32·0	16·0	34·0	7	3·0	17	. . .	. . .	4·49	. . .	. . .	14	12	8
4	44·7	25·7	19·0	33·0	20	5·0	17	78·9	29·8	2·51	3·50	. . .	13	10	4
4	41·5	28·7	12·8	30·0	3	4·0	18	. . .	. . .	2·45	4·40	. . .	13	9	10
. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	1·65	. . .	. . .	9	20	1
4	48·8	28·3	20·5	30·5	24	5·7	18	77·3	32·0	2·43	1·00	. . .	13	12	9
1	34·1	33·4	20·7	36·0	7	9·0	15	74·9	35·0	4·62	. . .	. . .	17	8	14
4	46·6	27·5	19·1	31·0	7	6·0	17	. . .	. . .	3·85	. . .	. . .	13	14	3
4	47·4	27·8	19·6	32·5	2	6·0	18	. . .	. . .	3·58	3·00	. . .	11	13	11
6	47·4	30·3	17·1	32·0	30	3·0	17	78·0	32·1	3·29	. . .	. . .	14	9	10
4	31·9	26·5	24·7	39·0	4	6·0	17	. . .	. . .	3·68	. . .	. . .	17	7	15
4	30·1	32·9	17·2	25·0	25	5·0	18	. . .	. . .	1·95	. . .	. . .	13	14	8
5	52·0	29·4	22·6	36·0	13	3·5	18	. . .	. . .	1·60	. . .	. . .	14	13	7
. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	·49	. . .	. . .	5	6	12
5	49·4	33·0	16·4	24·6	13	4·5	18	. . .	. . .	1·23	·50	. . .	8	19	8
4	45·3	33·4	11·9	22·0	20	2·0	31	. . .	. . .	. . .	. . .	. . .	19	11	10
4	48·2	28·8	19·4	32·0	27	6·0	13	76·7	33·5	3·61	. . .	. . .	13	7	14
1	45·0	30·0	15·0	28·0	24	2·0	17	. . .	. . .	4·67	. . .	. . .	14	9	11
4	46·6	28·6	18·0	30·0	13	5·0	16	. . .	. . .	4·19	. . .	. . .	16	12	8
4	45·6	32·0	13·6	23·0	20	5·0	14	. . .	. . .	2·41	4·00	. . .	13	. . .	. . .
4	49·6	30·3	19·3	37·0	2	5·0	18	84·5	34·5	2·44	. . .	. . .	14	13	6
4	47·7	32·5	15·2	29·0	2	5·0	18	76·9	32·3	2·11	. . .	. . .	14	13	8
4	50·2	31·9	18·3	28·5	25	4·2	18	77·8	34·5	1·05	. . .	. . .	6	8	10
4	48·9	32·5	16·4	34·0	29	6·0	30	80·0	33·0	4·03	. . .	. . .	17	7	10
1	52·9	37·3	15·6	32·0	24	4·0	22	81·0	40·0	2·76	. . .	. . .	10	13	11
4	50·0	31·4	18·6	38·0	27	4·0	17	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
4	50·2	28·3	21·9	37·0	2	7·0	18	84·6	33·2	2·03	. . .	. . .	7	. . .	. . .
1	52·8	31·0	21·8	40·0	2	6·0	18	74·7	33·4	2·44	. . .	. . .	8	15	7
. .	55·6	30·0	25·6	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. .	. . .
4	52·1	27·7	24·4	46·0	26	10·0	18	. . .	. . .	3·14	. . .	. . .	12	10	10
4	40·5	30·5	19·0	38·0	2	3·0	30	. . .	. . .	2·31	. . .	. . .	12	10	13
. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
1	52·0	29·5	20·5	36·0	30	10·0	9	. . .	. . .	3·64	. . .	. . .	12	8	10
5	48·6	29·3	19·3	29·2	13	3·2	18	86·7	33·7	2·20	. . .	. . .	10	9	8
4	. . .	. . .	. . .	. . .	. . .	. . .	. . .	76·2	33·8	. . .	. . .	. . .	. . .	13	7
4	54·6	33·1	19·5	34·0	24	5·0	15	. . .	. . .	2·30	. . .	. . .	12	9	11
4	50·7	31·9	18·8	40·0	25	7·0	14	. . .	. . .	2·22	·50	. . .	11	16	4
5	46·9	28·5	18·4	40·0	24	3·0	4	. . .	. . .	. . .	. . .	. . .	. . .	5	17
4	45·8	28·8	17·0	31·0	24	5·0	6	. . .	. . .	2·11	3·50	. . .	9	. . .	. . .
4	48·0	30·0	18·0	30·0	21	7·0	19	. . .	. . .	2·72	. . .	. . .	11	19	2
. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	4·00	. . .	. . .	9	. . .	. . .
1	49·9	29·2	20·7	30·0	27	5·1	23	89·2	33·8	3·03	. . .	. . .	10	6	8
4	50·5	30·2	20·3	38·0	2	5·0	17	77·1	33·3	2·35	. . .	. . .	14	11	10
4	51·0	33·0	18·0	31·0	24	4·0	18	79·0	32·0	2·03	. . .	. . .	7	15	8
4	48·0	31·0	17·0	29·0	26	5·0	18	78·0	36·0	1·66	. . .	. . .	8	18	2
4	49·4	29·0	20·4	35·0	2	4·0	18	. . .	. . .	2·24	. . .	. . .	9	16	8
4	51·0	36·1	14·9	24·0	25	5·0	14	71·8	32·7	·85	. . .	. . .	10	11	9
. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
4	47·4	28·6	18·8	33·0	21	6·0	18	. . .	. . .	3·31	1·75	. . .	13	9	13
1	49·4	31·9	17·5	37·0	25	0	4	79·6	32·5	2·66	. . .	. . .	11	15	7
1	51·2	31·4	19·8	34·0	1	8·0	16	81·2	36·0	4·29	. . .	. . .	13	5	17
4	38·8	26·2	12·6	30·0	4	2·0	23	76·7	26·8	3·28	5·25	. . .	9	10	14
4	42·7	28·4	14·3	25·0	1	8·0	29	80·4	29·5	3·93	5·00	. . .	15	3	13
4	46·5	29·2	17·3	30·0	13	5·0	17	. . .	. . .	2·67	1·80	. . .	11	7	12
4	41·8	29·8	15·0	30·0	29	2·0	30	. . .	. . .	5·09	. . .	. . .	14	8	7
1	52·7	31·6	21·1	34·0	24	9·0	15	77·7	36·7	3·30	. . .	. . .	16	12	7
4	44·3	24·0	20·3	32·0	20	1·0	18	. . .	. . .	2·91	7·00	. . .	11	8	8
4	42·6	28·4	14·2	28·0	20	4·0	18	72·5	31·5	3·53	6·00	. . .	13	. . .	. . .
. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
4	46·0	27·6	18·4	29·0	20	4·0	17	. . .	. . .	2·32	5·50	. . .	11	10	9
5	52·3	31·9	20·4	34·5	27	5·0	18	73·0	32·0	1·09	. . .	. . .	10	15	4

Number of Days.			Wind.			Observers.
			Prevailing Direction.			
Clear.	Fair.	Cloudy.	7 A. M.	2 P. M.	9 P. M.	
13	2	16	S	S	S	Prof. E. S. Breidenbaugh.
6	14	11	NW	NW	NW	Oscar D Stewart, Sgt. Sig. Corps
11	12	8	W	W	W	Miss E. A. G. Apple.
13	12	6	NW	NW	NW	C. M. Dechant, C.E.
. .	. . .	. . .	. . .	. . .	. . .	Dr. Charles B. Dudley.
13	9	9	NW	NW	NW	A. H. Boyle.
14	8	9	W	W	W	Prof. J. A. Stewart.
12	8	11	SW	SW	W	Miss Cora J. Wilson.
10	4	17	W	W	W	Charles Beecher.
9	10	12	SW	SW	SW	Geo. W. T. Warburton.
20	1	10	W	W	W	J. C. Hilsman.
12	9	10	W	NW	NW	J. L. Heacock.
8	14	9	SE	SW	SE	E. C. Lorentz.
14	3	14	W	W	W	T. B. Lloyd.
13	11	7	. . .	. . .	. . .	John J. Boyd.
9	10	12	W	W	W	Prof. Wm. Frear.
7	15	9	SW	SW	SW	Geo. H. Dunkle.
14	8	9	NW	NW	NW	Jesse C. Green, D.D.S.
13	7	11	W	W	W	W. T. Gordon.
6	12	13	W	. . .	NW	Benj. P. Kirk.
12	8	11	W	W	NW	Prof. Wm. F. Wickersham.
11	10	10	W	W	W	Rev. W. W. Deatrick, A.M.
7	14	10	SW	SW	SW	C. M. Thomas, B.S.
9	11	11	W	W	W	Nathan Moore.
12	8	11	W	W	W	Prof. John A. Robb.
. .	. . .	. . .	. . .	. . .	. . .	Robert M. Graham.
13	6	12	W	W	W	J. E. Pague.
13	5	13	E	E	E	Frank Ridgway, Sgt. Sig. Corps.
8	10	13	SW	SW	SW	Prof Susan J. Cunningham.
7	10	14	SW	SW	SW	Peter Wood, Sgt. Sig. Corps.
13	11	7	SW	SW	SW	Wm. Hunt.
. .	. . .	. . .	. . .	. . .	. . .	R. L. Haslet.
. .	. . .	. . .	. . .	. . .	. . .	Miss Mary A. Ricker.
15	7	9	W	W	W	Thomas F. Stoan.
.	. . .	. . .	. . .	. . .	. . .	Capt. W. C. Kimber.
10	10	11	W	. . .	NW	Prof. W. J. Swigart.
10	13	8	W	W	W	J. E. Rooney.
. . .	. . .	. . .	. . .	. . .	. . .	Prof. S C. Schmucker.
. . .	. . .	. . .	. . .	. . .	. . .	E. E. Weller.
8	10	13	W	W	W	Wm. T. Butz.
9	8	14	W	W	W	Wm. H. Kline.
13	7	11	W	W	W	Geo. W. Bowman, A.M., Ph.D.
9	11	11	SW	NW	SW	H. W. Mullen.
16	4	11	SW	SW	SW	M. H. Boye.
5	17	9	. . .	. . .	. . .	John C. Wuchter.
. . .	. . .	. . .	NW	NW	NW	H. D. Miller, M.D.
19	2	10	W	W	W	A. W. Betterly.
. . .	. . .	. . .	. . .	. . .	. . .	John S. Gibson, P. M.
6	8	17	SW	SW	SW	Prof. S. H. Miller.
11	10	10	NW	NW	NW	Culbertson & Lantz.
15	8	8	NW	NW	NW	Charles Moore, D.D.S.
18	2	11	NW	W	NW	Lerch & Rice.
16	8	7	W	W	W	Frank Mortimer.
11	9	11	SW	SW	SW	Luther M. Dey, Sgt. Sig. Corps.
. . .	. . .	. . .	. . .	. . .	. . .	C. L. Peck.
9	13	9	W	W	NW	E. C Wagner.
15	7	9	SW	SW	SW	J. M. Boyer,
5	17	9	SW	SW	SW	W. M. Schrock.
10	14	7	SW	SW	SW	E. S. Chase.
3	13	15	S	S	S	H. D. Deming.
7	12	12	SW	SW	SW	F. O. Whitman.
8	7	16	SW	SW	SW	Wm. Loveland.
12	7	12	W	SW	W	A L. Runion, M.D.
8	8	15	NW	NW	NW	Theodore Day.
. . .	. . .	. . .	. . .	. . .	. . .	John Torrey.
. . .	. . .	. . .	. . .	. . .	. . .	Hilary S. Brunot.
10	9	12	NW	NW	NW	Benj. M. Hall.
13	4	14	SW	SW	SW	Mrs. L. H. Grenewald.

T. F. Townsend, *Sergeant Signal Corps, Assistant.*

	Erie.	New Castle.	Greenville.	Columbus.	Pittsburgh.	Uniontown.	Clarion.	Indiana.	Johnstown.	Somerset.	Grampian Hills	Emporium.	Blue Knob.	Phillipsburg.	Petersburg.	Huntingdon.	Hollidaysburg.	Altoona.	Chambersburg.	State College.	York.	Lock Haven.	New Bloomfield.	Wellsboro.	Harrisburg.	Selins Grove.	Lancaster.	Le Roy.	Eagles Mere.	Myerstown.	Wysox.	Catawissa.	Girardville.	Wilkes-Barre.	South Eaton.	Drifton.	Reading.	Pottstown.	West Chester.	Coatesville.	Kennett Square.	Dyberry.	Honesdale.	Quakertown.	Swarthmore.	Philadelphia.	Seisholtzville.	Fredrick
1	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
2	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
3	·30	·03	·19	·25	·07	·20	. .	. .	·12	. .	·10	·20	. .	. .	·06	. .	·06	·04	. .	·02	·03	. .	·01	·22	. .	. .	. .	·14	·21	. .	·03	·10	. .	. .	. .	·07	·11	·08	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
4	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	·20	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	·13	·02	·01	·12	·12	. .	. .	·04	. .	. .	. .	. .
5	·18	·22	·29	·16	·05	. .	·17	. .	·03	. .	·08	·09	. .	. .	·02	. .	·05	. .	. .	. .	·04	. .	. .	·03	·01	. .	. .	·01	. .	·01	. .	. .	. .	. .	. .	·04	·02	. .	. .	. .	·06	. .	·01	. .	. .	. .	. .	. .
6	. .	. .	. .	. .	·01	. .	. .	. .	. .	·10	. .	. .	. .	·10	. .	. .	. .	. .	·04	. .	. .	. .	. .	. .	·01	. .	. .	. .	. .	. .	. .	·17	·03	·03	·02	. .	. .	·01	. .	·14	·13	. .	. .	. .	. .	. .	. .	. .
7	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	·07	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
8	·36	·05	. .	·45	·13	·41	·34	. .	·31	·80	·43	·50	. .	·35	·45	·26	·24	·08	·42	·23	·35	·55	·46	·40	·42	·35	. .	·16	·81	·38	·35	·20	·48	·20	·25	·35	. .	·25	·25	·18	·10	·47	·48	·47	·19	·03	·43
9	·06	. .	. .	·33	·22	. .	·25	. .	·02	·25	·25	·22	. .	·11	. .	·10	. .	·40	. .	·06	. .	·20	·04	·16	·02	·11	. .	·13	. .	·05	. .	. .	. .	·08	·13	. .	·15	·18	·11	·05	. .	·15	·10	·10	. .	·08	. .	. .
10	·18	. .	·62	·49	·27	·37	·19	. .	·34	. .	·16	·06	. .	·07	·27	·20	·27	. .	·18	·16	·02	·15	·12	·18	·06	. .	. .	·02	·12	·01	·08	·16	·20	·36	. .	·12	·01	. .	. .	·01	. .	·50	·01	. .	. .	. .	. .	. .
11	·49	1·20	·19	·50	·36	·44	·39	. .	·48	·20	·48	·57	. .	·40	·29	·35	·02	·43	·04	·24	·07	·30	·22	·38	·17	·21	. .	·13	·42	·20	·08	·12	·34	·03	·20	·32	·02	·11	·11	·08	. .	·51	·12	·18	·07	·14	·20
12	. .	. .	. .	. .	. .	. .	. .	. .	. .	·41	. .	. .	. .	·02	. .	. .	. .	·02	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
13	. .	. .	. .	. .	. .	. .	. .	. .	·04	·10	. .	. .	. .	. .	. .	. .	. .	. .	·07	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	·02	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
14	·54	·75	·40	·49	·62	·22	·86	. .	1·30	1·02	1·68	·40	. .	1·25	·42	1·30	1·47	1·10	·84	1·32	. .	·40	·90	·30	·46	·70	. .	·30	·35	·62	·75	·82	·71	·33	·41	·33	1·15	·77	·42	·35	. .	·60	·76	·63	·20	·20	. .	. .
15	·03	. .	. .	. .	. .	. .	. .	. .	. .	·10	. .	. .	. .	·10	. .	. .	. .	·37	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	·03	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
16	·06	·44	·12	. .	·16	·03	. .	. .	·10	·40	. .	. .	. .	. .	. .	. .	·08	. .	. .	·05	. .	·02	. .	·05	. .	. .	. .	. .	. .	. .	·30	·04	·04	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
17	·50	. .	·40	·55	·71	. .	·33	. .	·90	·20	·43	·52	. .	·35	·41	·40	·48	·37	·45	·36	·36	1·28	·26	1·64	·22	·50	. .	·85	·81	·42	·45	·43	·60	·78	·74	·42	·23	·22	·28	·22	·21	·20	·49	·33	·13	·11	. .	. .
18	·02	·18	·30	·01	·03	·10	. .	. .	·15	. .	·10	·13	. .	·02	·09	·02	·13	·07	. .	·14	·03	·10	·13	·10	·11	·30	. .	·06	·16	·06	·02	·05	·22	·07	·08	·11	·47	·22	·15	·23	. .	·40	·41	·16	·09	·03	·53	. .
19	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	·03	. .	. .	·01	·04	. .	. .	·02	. .	. .	. .	·04	·11	. .	·02	. .	. .	. .	. .	. .	·09	. .	·02	. .	·03	. .	·04	·02	. .	. .	. .	·02	. .	. .	. .
20	·38	·20	·06	·39	·15	. .	·33	. .	·12	·20	·20	·20	. .	. .	·09	·06	·10	. .	. .	·16	·03	·15	·10	·08	·06	·03	. .	·12	. .	. .	·10	·04	. .	. .	. .	·06	. .	. .	·03	. .	. .	. .	. .	. .	. .	. .	. .	. .
21	. .	. .	. .	. .	. .	. .	. .	. .	·02	. .	. .	. .	. .	·10	. .	. .	·01	·09	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	·01	·04	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
22	·17	·10	. .	·47	·13	. .	·15	. .	·13	. .	·28	·14	. .	·10	·07	·11	·07	·14	. .	·08	·02	·16	. .	·10	·03	·11	. .	·06	·22	·04	. .	·06	·11	·14	·07	. .	. .	. .	. .	. .	. .	·02	·06	·08	·03	. .	. .	. .
23	. .	. .	. .	. .	. .	. .	. .	·06	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
24	·14	·22	·46	·18	. .	. .	·10	. .	. .	. .	·10	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	·05	. .	. .	. .	. .	. .	. .	·05	·02	. .	. .	. .	. .	. .	. .	. .	. .	. .	·04	. .	. .	. .	. .	. .	. .
25	. .	. .	. .	. .	·01	·56	·10	. .	·16	. .	. .	·13	. .	·30	·02	. .	. .	. .	. .	·09	. .	·08	. .	. .	·04	·19	. .	. .	. .	. .	·19	. .	. .	. .	. .	. .	. .	. .	·01	·02	. .	. .	·01	. .	. .	. .	. .	. .
26	·42	·23	. .	·55	·14	·25	·40	. .	·36	. .	·38	·69	. .	. .	·12	·31	·34	·25	·03	·34	·16	·34	. .	·24	·46	. .	. .	·45	·18	·43	. .	·27	·43	·58	·29	·30	·22	·28	·35	·37	·15	·20	·25	·41	·37	·19	. .	. .
27	. .	. .	. .	. .	. .	. .	. .	. .	. .	·45	. .	. .	. .	·10	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	·37	. .
28	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
29	·20	. .	. .	·27	·01	. .	. .	. .	·04	. .	. .	. .	. .	. .	. .	·02	·03	. .	. .	. .	. .	·01	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
30	·01	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	·08	. .	·01	. .	·02	. .	. .	. .	·01	. .	. .	. .	. .	. .	. .	. .	. .	. .	·03	. .	. .	. .	. .	. .	. .	. .	·06	·05	. .	. .	. .	. .	. .	. .	. .
31	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	4·03	3·64	3·03	5·09	3·07	2·76	3·61	. .	4·62	4·29	4·67	3·85	. .	3·68	2·31	3·14	3·36	3·42	2·03	3.29	1·09	4·19	2·24	3·93	2·11	2·66	. .	2·45	3·28	2·20	2·51	2·41	3·31	2·72	2·32	2·11	2·35	2·03	1·95	1·62	·49	2·91	3·53	2·43	1·05	·85	1·53

	Erie.	New Castle.	Greenville.	Columbus.	Pittsburgh.	Uniontown.	Clarion.	Indiana.	Johnstown.	Somerset.	Grampian Hills.	Emporium.	Blue Knob.	Phillipsburg.	Petersburg.	Huntingdon.	Hollidaysburg.	Altoona.	Chambersburg.	State College.	York.	Lock Haven.	New Bloomfield.	Wellsboro.	Harrisburg.
January, . . .	2·71	3·17	3·52	3.22	2·50	2·34	3·35	2·94	. . .	3·48	3·32	2·75	. . .	2·41	. . .	2·84	2·56	1·82	. . .	1·97	. . .	3·48	3·52	7·02	2·86
February, . . .	1·57	3·33	1·18	1·53	1·58	2·43	. . .	2·43	. . .	3·13	1·96	1·61	. . .	1·87	. . .	0·97	1·91	1·24	. . .	. . .	. . .	1·74	1·24	2·98	1·48
March, . . .	1·73	2·73	. . .	1·63	2·32	3·60	1·91	1·47	. . .	2·52	2·57	1·44	. . .	2·27	. . .	3·17	3·69	2·37	. . .	. . .	. . .	2·63	3·91	3·24	3·26
April, . . .	3·64	6·06	2·50	3·24	3·62	4·47	2·09	4·50	. . .	4·54	4·61	3·66	. . .	6·09	. . .	4·42	4·07	3·44	. . .	3·65	3·91	3·97	3·88	8·15	3·96
May, . . .	2·51	3·20	2·57	2·88	6·45	6·93	4·59	4·71	. . .	8·32	1·60	8·04	. . .	5·28	. . .	7·18	7·43	4·75	. . .	. . .	5·65	. . .	. . .	0·06	3·45	9·51
June, . . .	6·02	6·50	3·51	5·12	4·93	7·36	. . .	3·39	. . .	3·87	3·71	4·63	. . .	5·84	. . .	5·60	2·71	4·73	. . .	5·87	5·13	. . .	6·25	10·40	7·18
July, . . .	1·68	. . .	1·04	2·00	5·48	4·21	. . .	. . .	. . .	5·06	7·31	7·03	4·70	5·21	. . .	5·38	6·22	4·60	. . .	4·68	4·34	. . .	6·08	3·06	8·68
August, . . .	2·26	2·28	1·83	2·37	1·88	3·86	. . .	. . .	3·95	3·35	4·00	3·23	2·40	2·40	3·12	1·80	1·37	1·52	. . .	3·15	2·83	. . .	2·75	0·81	2·58
September, . .	4·85	4·01	3·68	5·25	2·87	3·79	3·32	4·60	4·59	2·94	2·76	2·84	4·70	2·91	3·57	4·53	3·01	2·74	4·13	3 67	6·87	4·73	5·02	2·71	4·53
October, . . .	3·37	1·88	2 74	3·44	2·06	3·31	2.17	3·52	2·55	2·61	3 21	3·70	4·30	3·54	3·34	3·67	2·90	2·38	3·24	3·36	4·03	. . .	4·35	5·61	3·33
November, . .	3·29	2·89	2·72	4·00	4·61	8·90	3·73	5·20	5·33	7·22	3·86	5·11	8·47	5·22	7·25	6·65	6 00	4·02	5·73	6·48	8·28	6·96	7·31	9·07	6·59
December, . .	4·03	3·64	3·03	5·09	3·07	2·76	3·61	. . .	4·62	4·29	4·67	3·85	. . .	3·68	2·31	3·14	3·36	3·42	2·03	3·29	1·09	4·19	2·24	3·93	2·11
Annual, . . .	37·66	. . .	. . .	39·77	41·37	53·96	. . .	. . .	. . .	51·33	43·58	47·89	. . .	46·72	. . .	49·35	45·23	37·03	. . .	. . .	. . .	. . .	52·61	60·45	56·07

	Pottstown.	West Chester.	Coatesville.	Kennett Square.	Dyberry.	Honesdale.	Quakertown.	Swarthmore.	Philadelphia.	Seisholtzville.	Frederick.	Ottsville.	Smith's Corner.	Doylestown.	Lansdale.	Forks of Neshan'y.	Germantown.	Point Pleasant.	Bethlehem.	Canonsburg.	Carlisle.	Centre Valley.	McConnellsburg.	Westtown.	Lewisburg.
January, . . .	4·12	4·78	4·33	. . .	. . .	4·15	4·58	4·80	3·75	4·28	3·44	4·79	4·19	4·32	2·95	3·55	3·82	4·64	. . .	. . .	3·49	. . .	3·53	. . .	. . .
February, . . .	1·92	2·46	1·85	. . .	. . .	2·10	2·38	1·92	2·00	2·13	1·84	2·07	2·22	2·05	1·63	2·03	2·19	2·20	1·94	. . .	1·68	. . .	1·65	1·72	. . .
March, . . .	3·73	5·44	4·49	. . .	1·74	1·88	3·47	3·43	2·58	3·59	2·74	4·42	3·35	3·77	2·98	3·35	3·34	3·45	. . .	. . .	1·91	. . .	4·70	. . .	. . .
April, ...	6·15	5·46	7·08	. . .	4·55	5·55	4·83	3·51	3·17	6·22	3·86	4·64	5·02	4·92	4·90	4·68	3·20	5·11	4·29	. . .	4·56	. . .	5·28	. . .	. . .
May, ...	7·47	5·78	5·29	3·18	4·72	5·47	5·45	5·64	4·32	4·54	4·65	5·85	4·75	4·82	4·35	5·70	5·73	5·59	4·32	. . .	4 52	. . .	12·41	. . .	. . .
June, ...	6·20	5·38	5·99	. . .	4·24	3·13	7·31	5·48	3·39	7·91	6·41	7·58	7·54	5·82	5·45	4·49	3·36	5·32	5·28	. . .	4·59	. . .	5·17	. . .	. . .
July.	12·50	12·49	12·93	. . .	6·53	5·55	11·54	8·74	8·29	11·76	12 69	13·19	12·30	11·46	15 02	10·36	10·50	12·30	9·93	. . .	. . .	. . .	8·23	. . .	. . .
August, ...	5·05	4·43	3·05	. . .	2·85	2·60	4·76	3·52	7·07	4·15	3·83	5·13	4·88	4·28	4·66	5·30	6·02	3·75	4·10	1·64	2·49	. . .	. . .	. . .	. . .
September, . .	8·44	9·95	9·12	10·01	4·18	5·90	8·06	8·04	4·66	7·32	6·68	7·38	8·07	8·61	8·32	8·76	5·56	8·14	6·14	3·41	. . .	. . .	. . .	. . .	. . .
October, . . .	4·56	4·97	4·61	5·04	4·03	4·02	5·23	5·29	3·76	5·17	4·62	5·09	4·99	4·27	5·02	4 42	. . .	5·06	3·29	2·87	3·75	3·09	3·14	5·37	3·04
November, . .	9·15	9·91	8·60	8·92	5·70	5·31	8·88	6·74	6·76	9·70	7·63	8 87	9·06	10·05	8·11	7·43	7·78	8·63	8·71	4·91	9·03	7·88	6·51	8·13	7·13
December, . .	2·03	1·95	1·60	0·49	2·91	3·53	2·43	1·05	0·85	1·53	1·88	1·97	2·36	2·30	1·71	1·65	0·91	1·69	1·66	3·30	2·44	2·30	2·44	1·23	2·67
Annual, . . .	71·32	73·00	68·94	. . .	. . .	49·19	68·92	58·36	50·60	68·30	60·27	71·09	68 73	66·67	65·10	61·72	. . .	65·88	. . .	. . .	. . .	. . .	. . .	. . .	. . .

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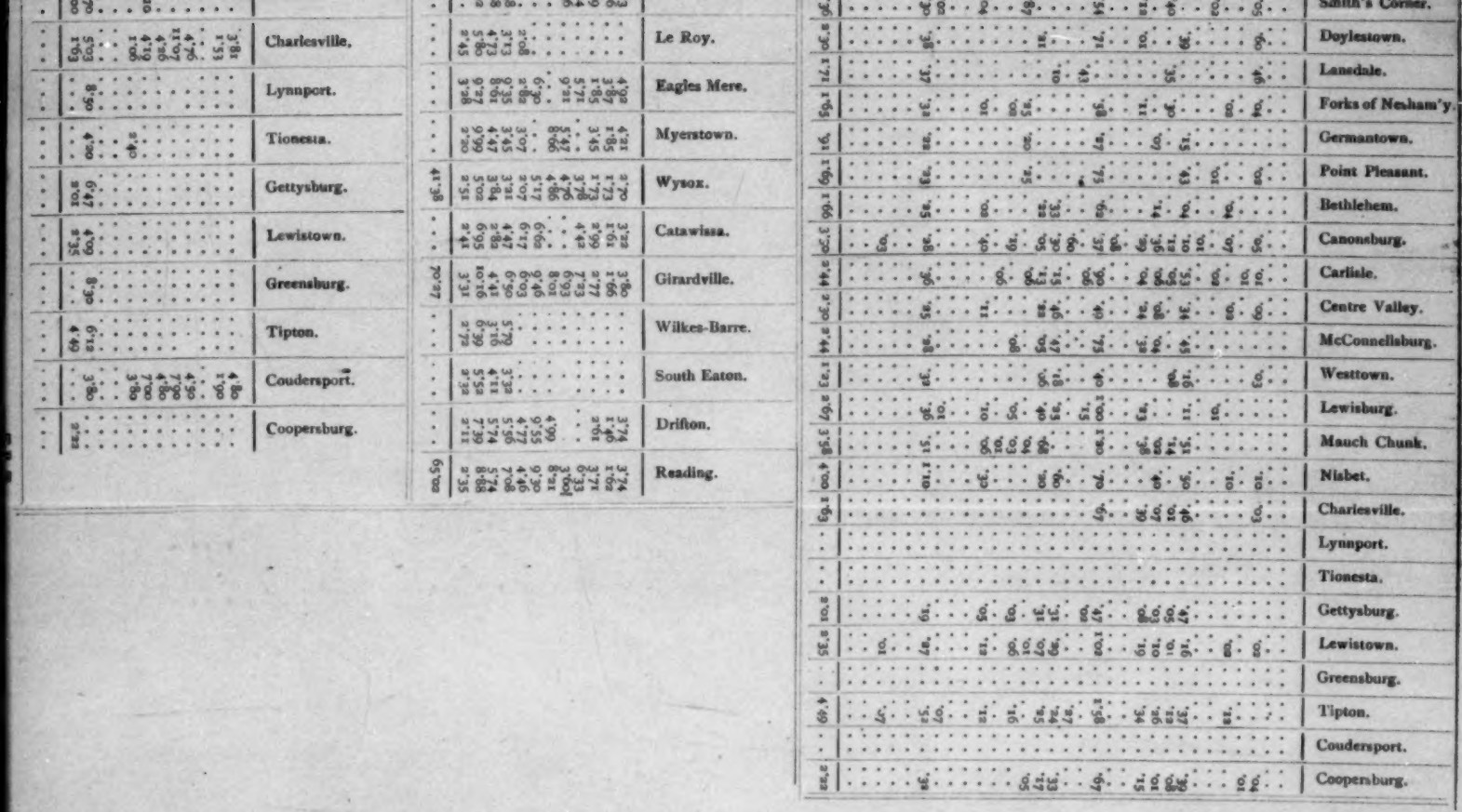
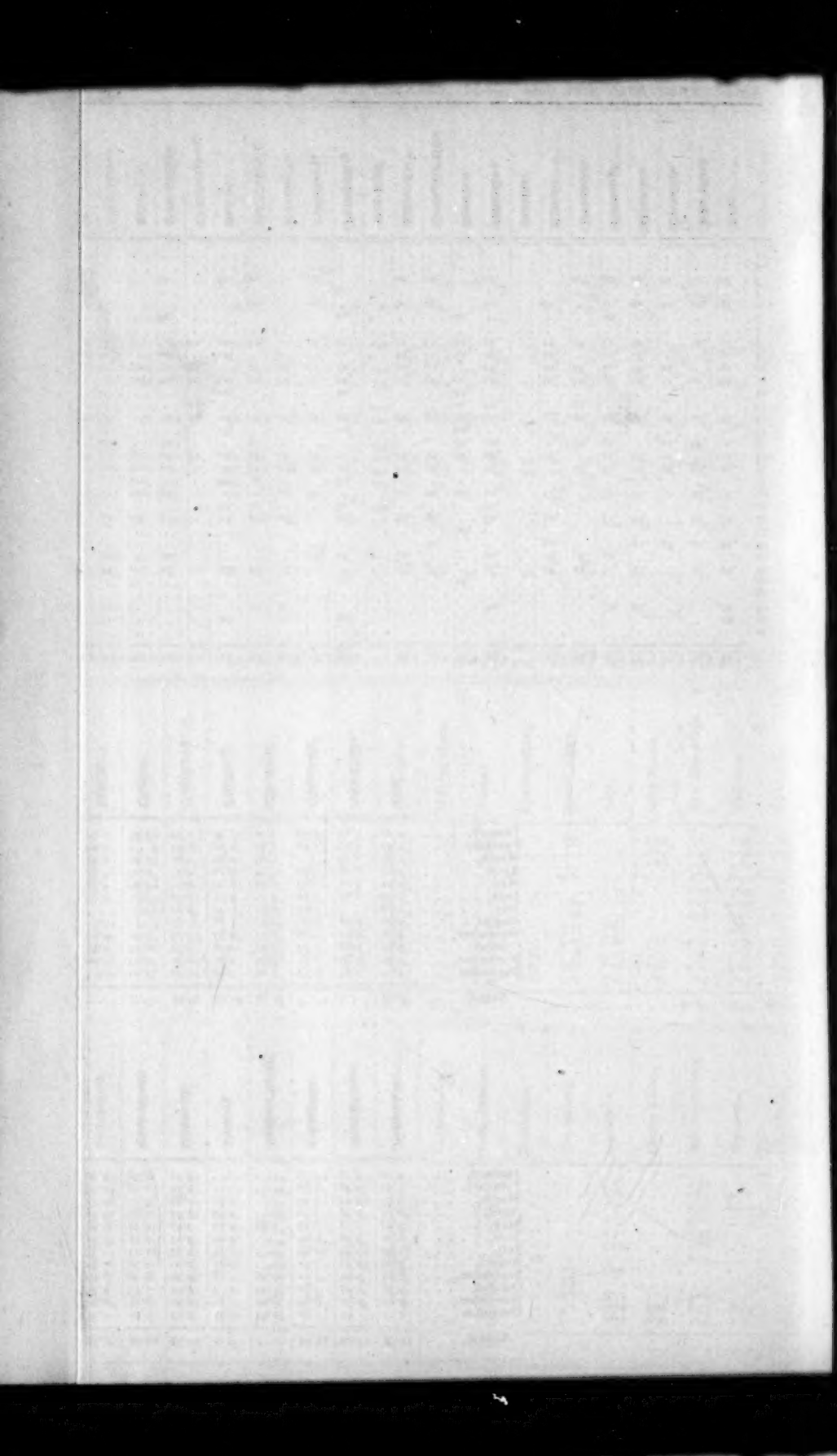




Emporium, 1st, 4th, 7th, 10th, 12th, 24th, 28th, 31st; State College, 1st, 7th, 8th, 10th, 16th, 24th; Phillipsburg, 4th, 12th, 23d, 24th, 31st; Westtown, 1st, 7th, 16th, 24th; Grampian Hills, 1st, 12th, 16th, 19th, 24th, 31st; Lock Haven, 30th; Catawissa, 1st, 5th, 12th, 14th; Carlisle, 1st, 6th, 7th, 8th, 24th; Chambersburg, 1st, 4th, 5th, 7th, 10th, 16th; Huntingdon, 1st, 2d, 4th, 10th, 12th, 16th, 24th; Petersburg 2d, 3d, 4th, 7th, 10th, 16th, 23d, 31st; New Castle, 1st, 2d, 4th, 7th, 12th, 31st; Annville, 2d; Nisbet, 2d, 4th, 6th, 7th, 9th; Lewistown, 1st, 2d, 4th, 7th, 16th, 24th, 31st; Bethlehem, 1st, 4th, 15th, 24th, 28th, 31st; Girardville, 1st, 2d, 3d, 4th, 5th, 7th, 8th, 12th, 15th, 21st, 24th; Selins Grove, 2d, 4th, 6th, 7th, 8th, 10th, 12th, 16th, 24th, 28th, 31st; Eagles Mere, 1st, 6th, 12th, 16th, 24th; Wellsboro, 1st, 2d, 4th, 5th, 7th, 8th, 10th, 12th, 14th, 15th, 24th, 27th, 28th, 30th, 31st; Columbus, 1st, 2d, 4th, 5th, 6th, 7th, 10th, 12th, 14th, 15th, 16th, 20th, 21st, 22d, 23d, 24th, 26th, 27th, 28th, 29th, 30th, 31st; South Eaton, 1st, 2d, 3d, 4th, 5th, 6th, 7th, 8th, 12th, 13th, 14th, 15th, 16th, 20th, 21st, 22d, 23d, 24th, 26th, 27th, 28th, 29th, 30th, 31st; York, 2d, 3d, 5th, 6th, 7th, 8th, 10th, 16th, 21st, 24th, 27th, 28th, 29th, 30th, 31st; Coopersburg, 16th.

Sleet.—Tipton, 14th; Le Roy, 14th; Forks of Neshaminy, 14th, 15th; Coatesville, 14th; Grampian Hills, 14th; Lock Haven, 5th; Myerstown, 14th; Annville, 5th, 15th; Centre Valley, 14th; Nisbet, 14th; Greenville, 5th; Lewistown, 3d, 14th; Wellsboro, 14th; Dyberry, 29th; South Eaton, 14th.

Coronæ.—Charlesville, 31st; Blue Knob, 12th; Tipton, 28th, 30th; Le Roy, 4th; Rimersburg, 4th; Lewistown, 3d, 29th; Eagles Mere, 12th; Dyberry, 10th, 28th, 31st.

Solar Halos.—Le Roy, 10th, 16th, 30th; Huntingdon, 4th; Wellsboro, 16th, 25th; Dyberry, 16th.

Lunar Halos.—Gettysburg, 28th; Charlesville, 2d, 9th, 28th; Reading, 28th; Blue Knob, 4th, 25th, 28th, 30th; Hollidaysburg, 4th, 28th, 29th; Le Roy, 10th, 28th, 30th; Quakertown, 28th; Phillipsburg, 1st, 4th, 28th; Coatesville, 2d, 28th; Rimersburg, 1st, 4th, 25th; Philadelphia, 28th, 29th; Grampian Hills, 4th, 16th, 28th; Lock Haven, 28; Carlisle, 1st, 2d, 24th, 27th, 30th; Petersburg, 10th, 15th, 16th, 28th, 31st; Myerstown, 4th; Centre Valley, 28th; Greenville, 1st, 28th, 30th; Lewistown, 4th, 28th, 30th; New Bloomfield, 28th; Girardville 28th, 30th, 31st; Selins Grove, 28th; Somerset, 9th, 15th, 28th; Eagles Mere, 4th, 14th, 28th; Dyberry, 4th, South Eaton, 28th; York, 2d.

Meteors.—Charlesville, 28th; Blue Knob, 19th; Quakertown, 21st; Phillipsburg, 1st, 12th; Rimersburg, 6; Eagles Mere, 3d, 19th; Dyberry, 12th.

Parhelias.—Coatesville, 20; Eagles Mere, 10; Dyberry, 7th, 10th.

WEATHER FORECASTS.

Percentage of local verifications of weather and temperature signals as reported by displaymen for December, 1889:

Weather, 80 per cent.

Temperature, 87 per cent.

TEMPERATURE AND WEATHER SIGNAL DISPLAY STATIONS.

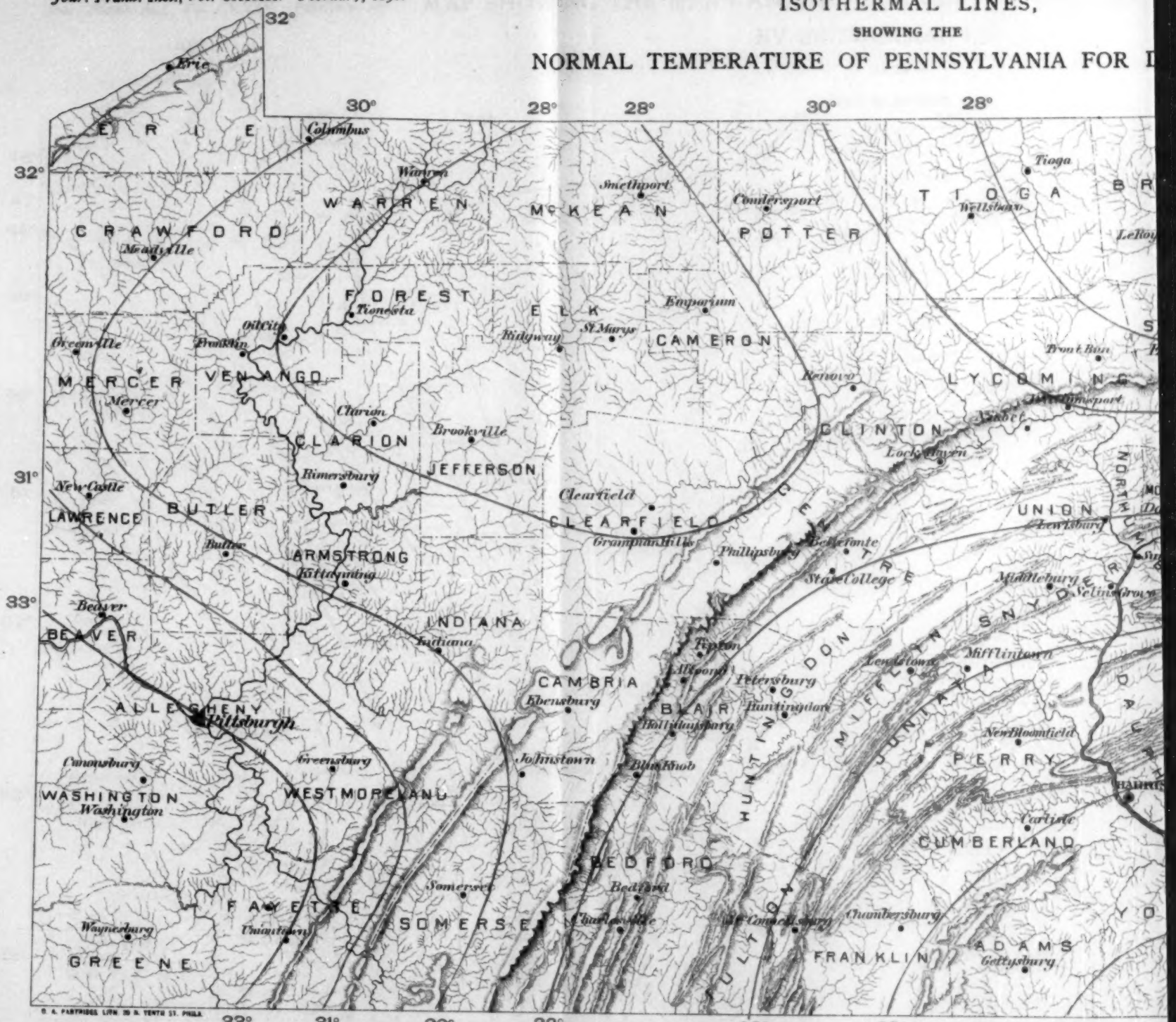
Displayman.	*Station.*
U. S. Signal Office,	Philadelphia.
Wanamaker & Brown,	"
Pennsylvania Railroad Company,	"
Continental Brewing Company,	"
Samuel Simpson,	"
B. T. Babbitt,	"
Western Meat Company,	"
Neptune Laundry,	"
Chester Oil Company,	Chester.
C. W. Burkhart,	Shoemakersville.
A. N. Lindenmuth,	Allentown.
C. B. Whitehead,	Bradford.
Capt. Geo. R. Guss,	West Chester.
Werner & Son,	Emporium.
C. E. Lenhart,	Latrobe.
Thomas F. Sloan,	McConnellsburg.
J. H. Fulmer,	Muncy.
W. T. Butz,	New Castle.
S. W. Morrison,	Oxford.
Capt. A. Goldsmith,	Quakertown.
J. L. Morrison,	Sharon.
Wm. A. Engel,	Shenandoah.
Wm. Schrock,	Somerset.
Postmaster,	Meadville.
Frank Ross,	Oil City.
Lerch & Rice,	Bethlehem.
John W. Aitken,	Carbondale.
Signal Office,	Erie.
J. R. Raynsford,	Montrose.
E. P. Wilbur & Co.,	South Bethlehem.
Agricultural Experiment Station,	State College.
Signal Office,	Pittsburgh.
E. H. Baker,	Williamsport.
New Era,	Lancaster.
State Normal School,	Clarion.
Clarion Collegiate Institute,	Rimersburg.
E. S. Chase,	Eagles Mere.
Thiel College,	Greenville.
D. G. Hurley,	Altoona.
J. E. Forsythe,	Butler.
James H. Fones,	Tionesta.
Wister, Hacker & Savage,	Germantown.
W. J. Thompson & Co.,	Clifton Heights.
Steward M. Dreher,	Stroudsburg.

Displayman.	*Station.*
State Normal School,	Millersville.
E. C. Wagner,	Girardville.
Hartford P. Brown,	Rochester.
L. H. Grenewald,	York.
J. E. Pague,	Carlisle.
C. L. Peck,	Coudersport.
H. D. Miller,	Drifton.
Smith Curtis,	Beaver.
M. Tannehill,	Confluence.
S. C. Burkholder,	Pollock.
Robt. M. Graham,	Catawissa.
Henry F. Bitner,	Millersville.
A. J. Edelman,	Pottstown.
A. M. Wildman,	Langhorne.
N. E. Graham,	East Brady.
B. F. Gilmore,	Chambersburg.
Frank M. Morrow,	Altoona.
A. Simon's Sons,	Lock Haven.
E. W. McArthurs,	Meadville.
J. K. M. McGowan,	Lock No. 4.
Raftsman's Journal,	Clearfield.
W. S. Ravenscroft,	Hyndman.
R. C. Schmidt & Co.,	Belle Vernon.
Jesse R. Brown,	Lehmasters.
H. W. Mullen,	Centre Valley.
Mayer Bros.,	Bloomsburg.
E. C. Lorentz,	Johnstown.
W. M. James,	Ashland.
Miller & Allison,	Punxsutawney.
Dr. A. L. Runion,	Canonsburg.
E. J. Sellers,	Kutztown.
T. F. Heebner,	Scranton.
H. J. Fosnot,	Lewistown.

ISOTHERMAL LINES,

SHOWING THE

NORMAL TEMPERATURE OF PENNSYLVANIA FOR I

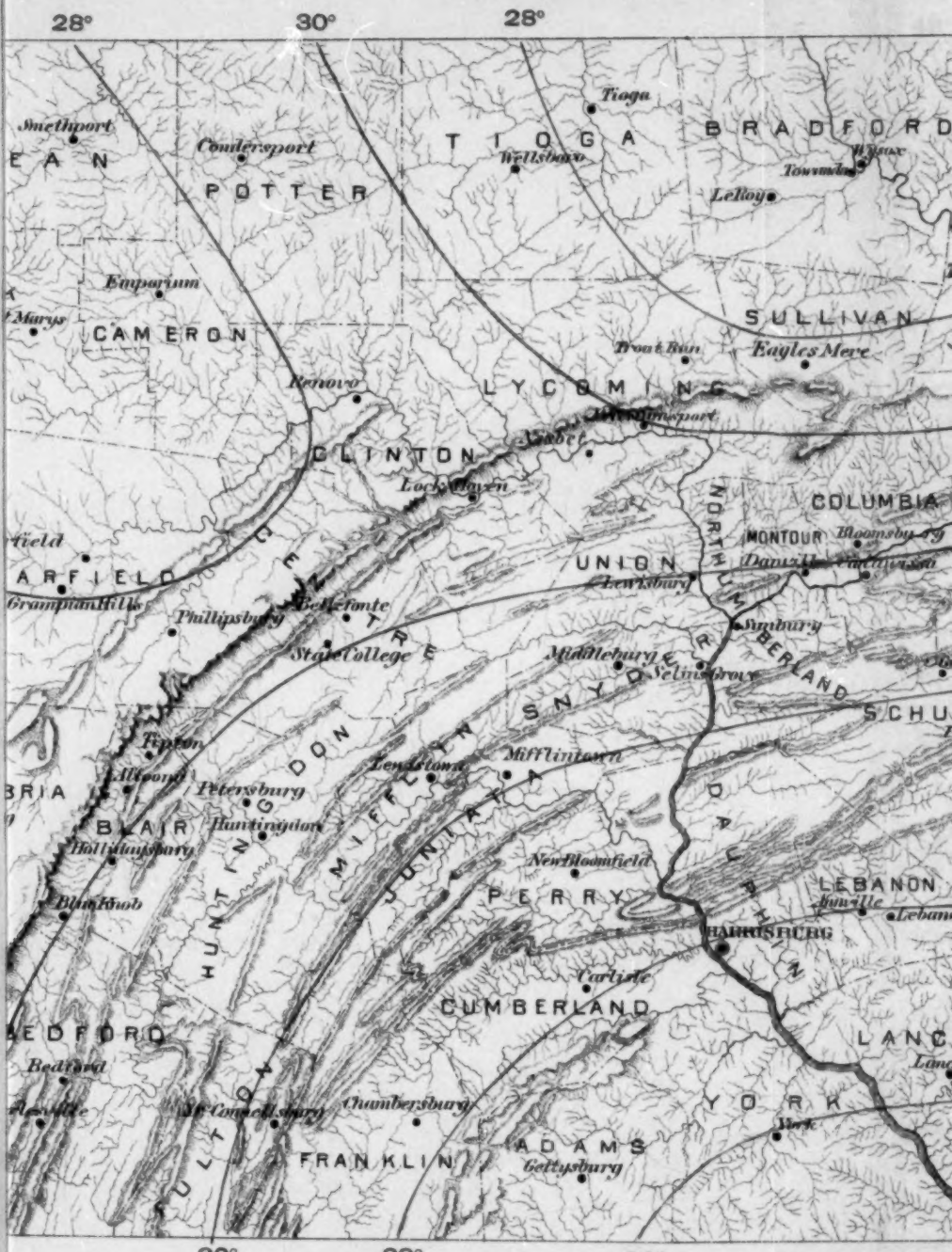


C. A. PARTRIDGE, LITH. 20 S. TENTH ST. PHILA.

ISOTHERMAL LINES,

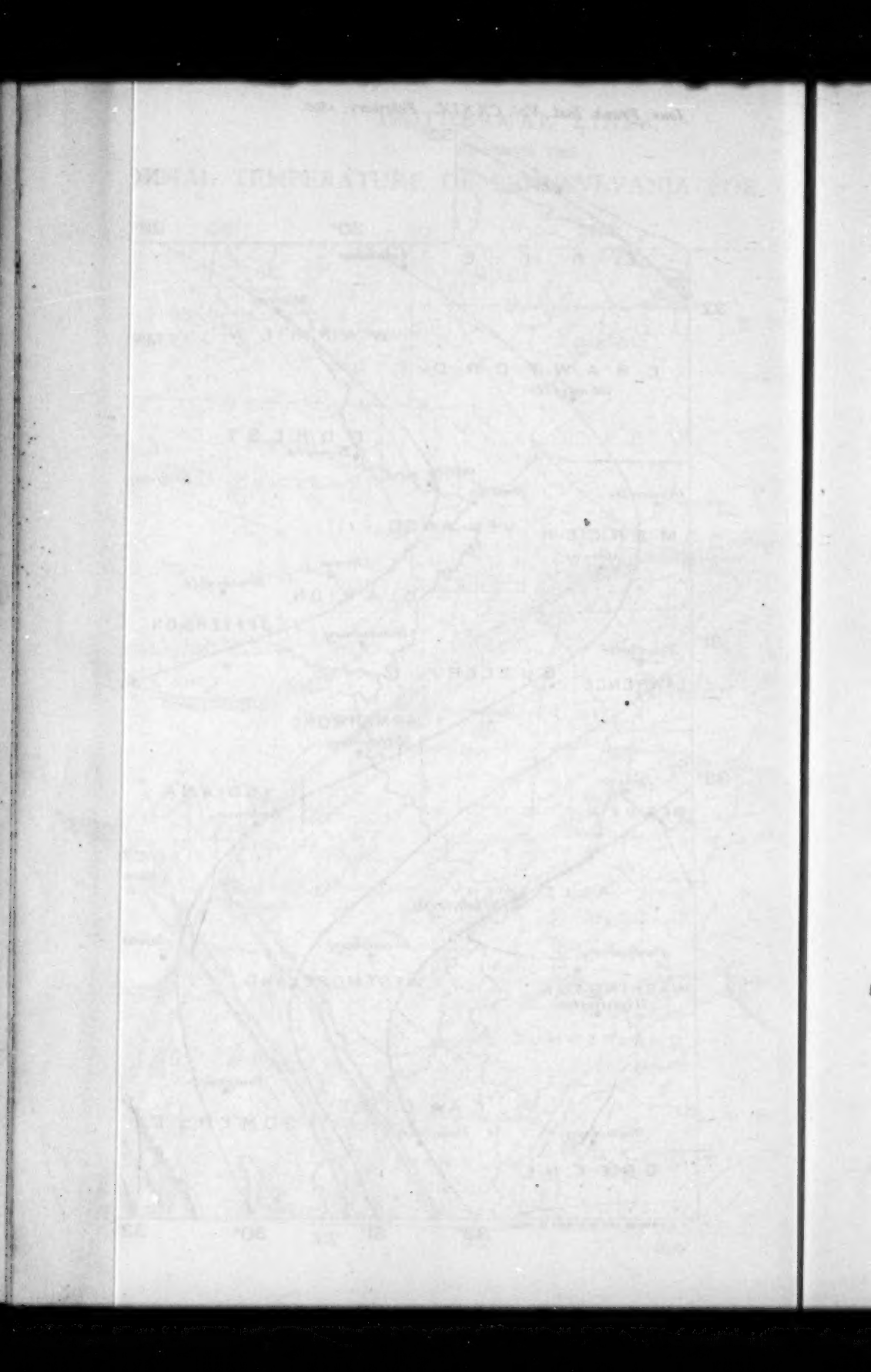
SHOWING THE

MAL TEMPERATURE OF PENNSYLVANIA FOR DECEMBER.



MBER.

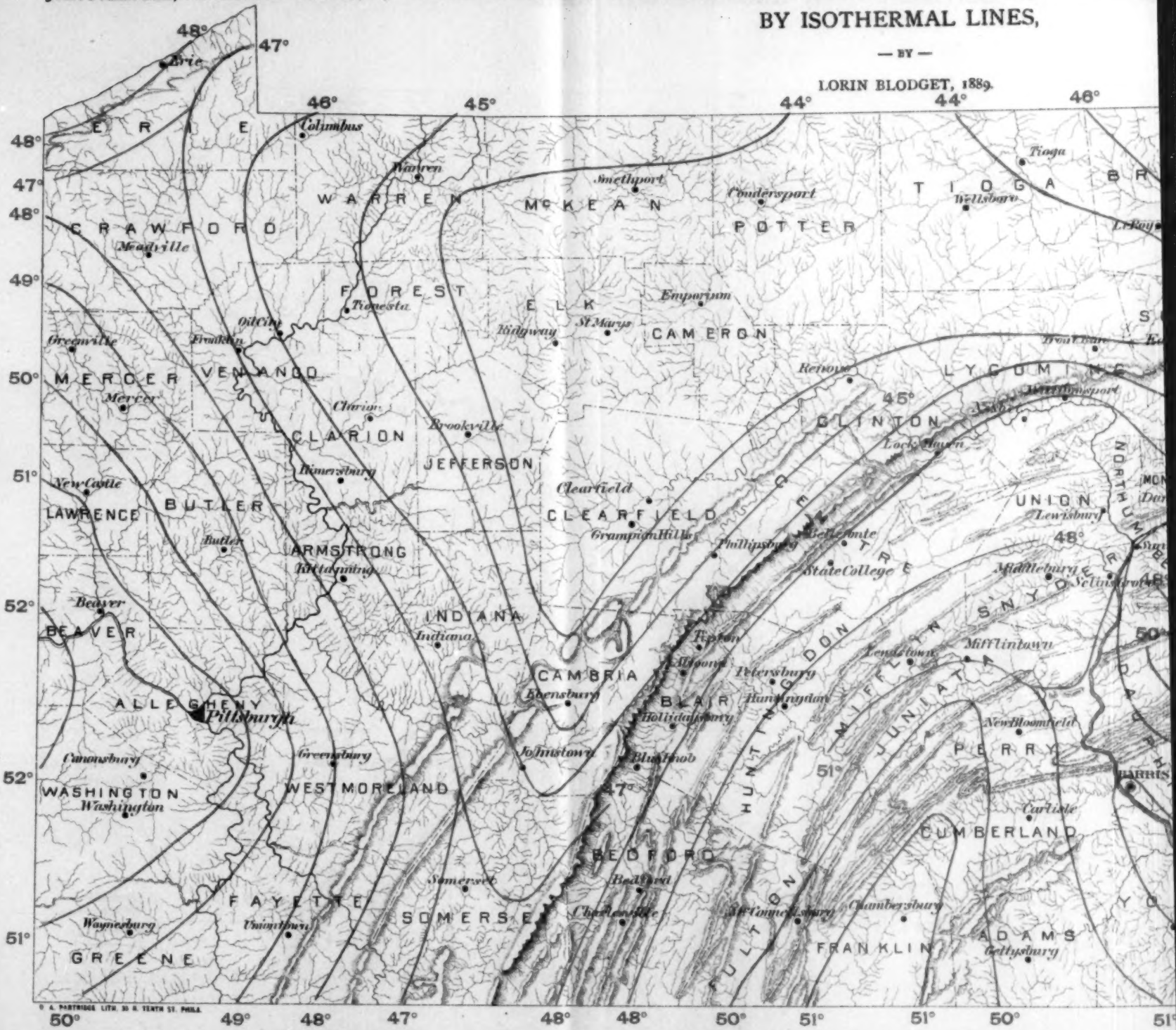
Montrose
SUSQUEHANNA
WAYNE
Dyberry
28°
Honesdale
30°
Tunkhannock
South Canaan
Scranton
Bloomsburg
Milford
PIKE
Wilkesbarre
LUZERNE
30°
MONROE
Stroudsburg
Bloomsburg
Drifton
CARBON
Mauch Chunk
32°
NORTHAMPTON
Easton
Girardville
SCHUYLKILL
Pottsville
Lynnport
Bethlehem
LEHIGH
Allentown
Hamburg
33°
Quakertown
BERKS
BUCKS
Reading
Doylestown
Lebanon
34°
Pottstown
MONTGOMERY
Norristown
LANCASTER
CHESTER
Lancaster
West Chester
Swarthmore
PHILADELPHIA
Westtown
Media
35°
DELAWARE
Kennett Square
35°



MAP SHOWING THE MEAN ANNUAL DISTRIBUTION OF HEAT BY ISOTHERMAL LINES,

— BY —

LORIN BLODGET, 1889.



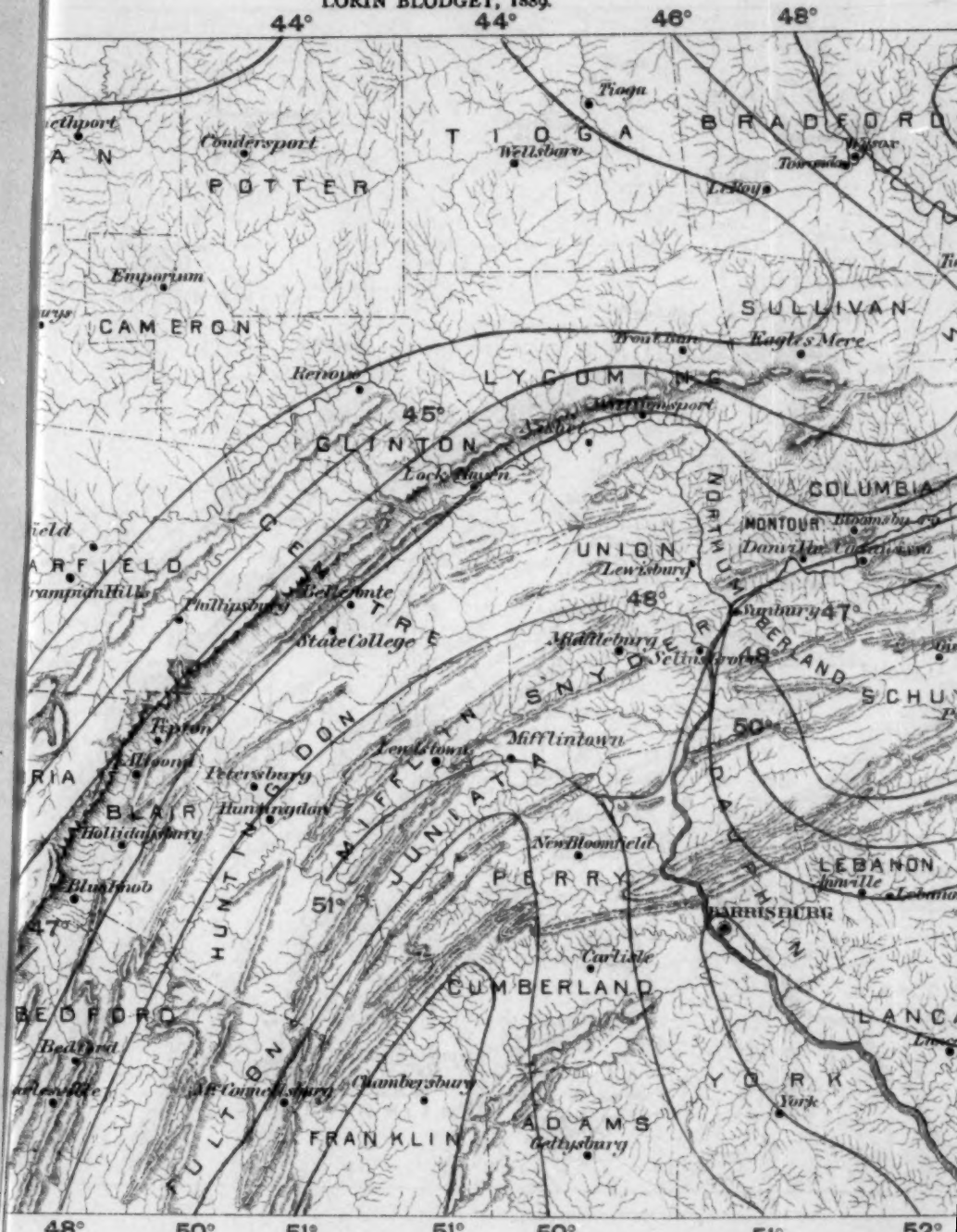
C. A. PARTRIDGE, LITH. 30 S. TENTH ST. PHILA.

THE MEAN ANNUAL DISTRIBUTION OF HEAT

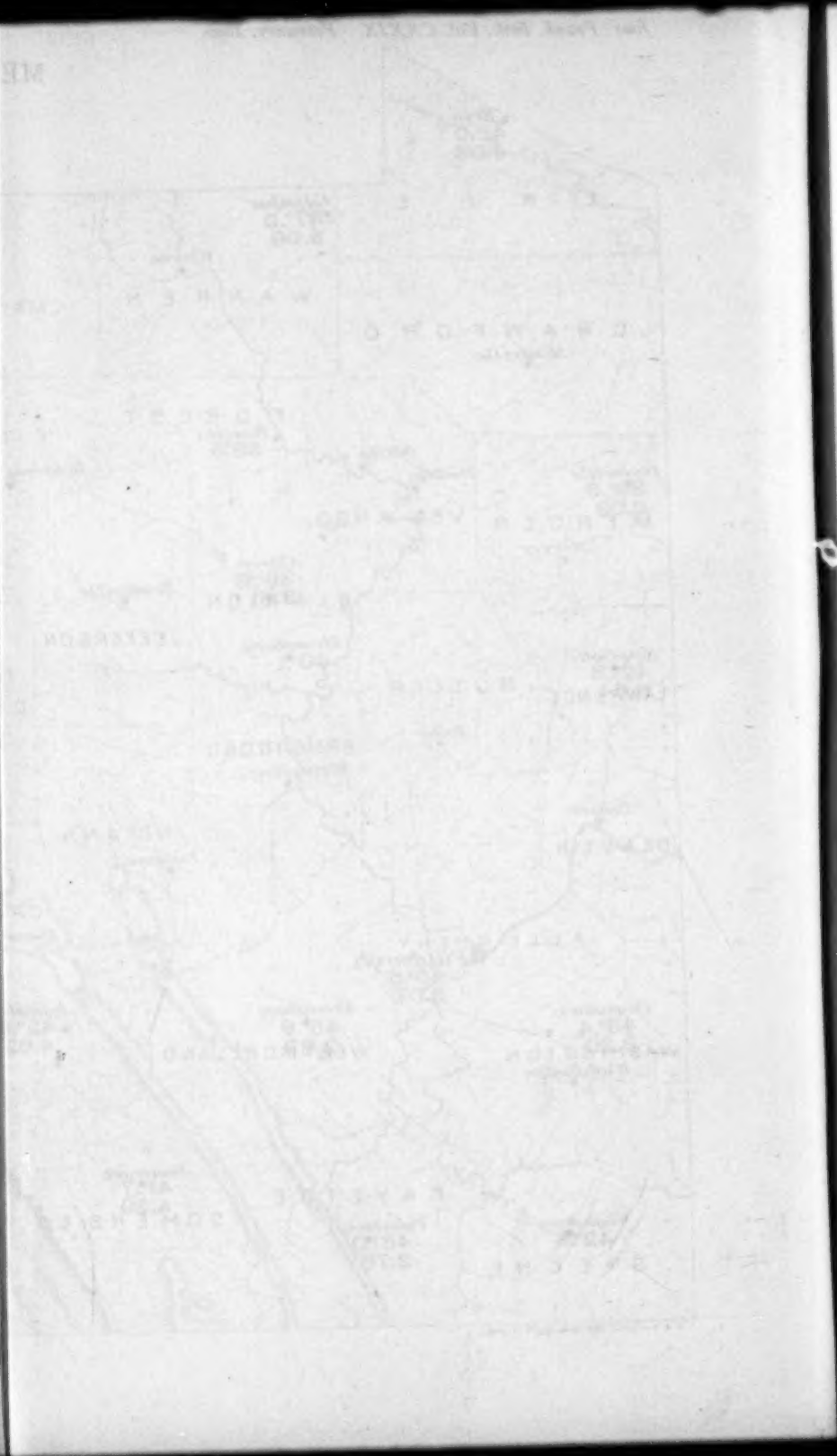
BY ISOTHERMAL LINES,

— BY —

LORIN BLODGET, 1889.



44°
Montrose
SUSQUEHANNA
WAYNE
Honesdale
46°
Tunkhannock
South Eaton
WYOMING
LACKAWANNA
Scranton
Blooming Grove
Milford
44°
PIKE
Wilkesbarre
46°
LUZERNE
MONROE
51°
Berwick
47°
CARBON
Mauch Chunk
NORTHAMPTON
Easton
48°
SCHUYLKILL
Pottsville
Lynnport
Bethlehem
LEHIGH
50°
Allentown
Hamburg
Centre Valley
Quakertown
BUCKS
Doylestown
51°
BERKS
Reading
MONTGOMERY
Pottstown
Norristown
PHILADELPHIA
LANCASTER
CHESTER
52°
Lancaster
Coatesville
West Chester
Swarthmore
Media
Westtown
53°
DELAWARE
Kennett Square
52°
53°



PENNSYLVANIA STATE WEATHER SERVICE.

MONTHLY WEATHER REVIEW

FOR JANUARY, 1890.

Prepared under the Direction of the Committee on Meteorology of the FRANKLIN INSTITUTE.

HALL OF THE FRANKLIN INSTITUTE,
PHILADELPHIA, January 31, 1890.

TEMPERATURE.

The mean temperature of the State for January, 1890, determined from 64 stations was 37°·7, which is about 11° above the normal, which makes this month the warmest January since 1880. The mean of the daily maximum and minimum temperatures 46°·1 and 28°·9 give an average daily range of 17°·2.

Greatest local monthly range 67° at Blue Knob.

Least local monthly range 46° at Annville, Catawissa and Myerstown.

Greatest daily range 44° on 12th at Chambersburg.

Least daily range 2° on 7th at Tipton.

The averages of the greatest and least daily ranges were 34°·0 and 5° 8.

The highest temperatures recorded during the month were Coatesville, 77°; Gettysburg, 75°; McConnellsburg, 74°; Centre Valley, 74°, and Chambersburg, 73°.

The lowest were Blue Knob, minus 2°; Dyberry, 2°; Somerset, 3°, and Eagles Mere, 5°.

Most stations report the warmest day of the month on the 12th, and the coldest on the 22d.

According to the mean temperatures, Uniontown, 43°·2; Philadelphia, 41°·8, and Waynesburg, 41°·8 were the warmest stations, and Eagles Mere, 31°·0, and Dyberry, 31°·6, the coldest.

BAROMETER.

The mean pressure for the month, 30·22, is about one-tenth above the normal. Philadelphia reports the highest, 30·760 on the 1st, and Erie the lowest 29·400 on the 13th.

PRECIPITATION.

The average rainfall of the State was 3·04 inches, which is about ·30 below the normal. The western part of the State received an excess, and the eastern portion a deficiency. The largest totals in inches [rainfall and melted snow] were Clarion, 6·87; Uniontown, 6·10; Tionesta, 6·00 and Somerset, 5·60.

The least were Chambersburg, 1·80; South Eaton, 1·60; Charlesville, 1·52; and New Bloomfield, 1·47. The heaviest rainfall occurred on the 15th, at which time over one inch was reported from several stations.

The snowfall was very light. The greatest totals for the month were Blue Knob, 16 inches; Greenville, 11 inches; Honesdale, 10 inches; Eagles Mere, 8 inches, and Somerset, 7 inches. Several stations report none during the month.

WIND AND WEATHER.

The prevailing wind was from the west and northwest. On account of the high temperature the weather was favorable for out-door pursuits. Building operations have scarcely been interrupted on account of cold.

Average Number.—Rainy days, 14; clear days, 7; fair days, 8; cloudy days, 16.

MISCELLANEOUS PHENOMENA.

Thunder-storms.—Emporium, 13th; Tionesta, 1st; Annville, 20th; Centre Valley, 13th.

Hail.—Blue Knob, 21st; Annville, 24th; Wellsboro, 15th; Dyberry, 11th, 15th.

Snow.—Gettysburg, 23d; Charlesville, 23d; Blue Knob, 1st, 7th, 8th, 9th, 16th, 22d, 23d, 24th; Hollidaysburg, 8th, 16th, 23d; Tipton, 7th, 8th, 16th, 20th, 23d; Le Roy, 8th, 9th, 23d, 24th; Forks of Neshaminy, 4th, 18th, 19th, 25th, 29th; Quakertown, 9th, 16th, 17th, 21st, 23d, 24th; Johnstown, 7th, 8th, 9th, 16th, 23d, 24th, 25th; Emporium, 8th, 15th, 16th, 17th, 22d, 23d, 25th; Mauch Chunk, 10th, 23d; State College, 8th, 16th, 23d; Phillipsburg, 8th, 16th, 21st, 23d, 24th; West Chester, 23d; Coatesville, 23d, 24th; Westtown, 23d; Rimersburg, 7th, 8th, 9th, 16th, 17th, 23, 24th; Clarion, 7th, 8th, 29th; Grampian Hills, 8th, 16th, 22d, 23d, 24th; Lock Haven, 9th. 23d; Catawissa, 8th, 16th, 21st, 23d, 24th; Harrisburg, 23d, 24th; Uniontown, 9th, 16th, 21st, 23d, 25th; Tionesta, 8th, 22d, 23d, 24th; Huntingdon, 9th, 16th, 24th; Petersburg, 8th, 16th, 21st, 23d, 24th; Lancaster, 21st, 23d; New Castle, 7th, 8th, 16th, 23d; Myerstown, 23d, 24th; Annville, 16th, 21st, 23d, 24th, 30th, 31st; Centre Valley, 16th, 23d, 24th; Wilkes-Barre, 2d, 23d; Nisbet, 9th, 23d; Greenville, 7th, 8th, 9th, 10th, 13th, 15th, 16th, 17th, 21st, 22d, 23d, 24th, 29th; Lewistown, 9th, 16th, 21st, 23d, 24th; Bethlehem, 8th, 23d, 24th; New Bloomfield, 16th, 21st, 24th; Girardville, 8th, 23d, 24th; Somerset, 10th, 16th, 17th, 23d, 24th; Eagles Mere, 7th, 8th, 23d, 24th; Lewisburg, 23d; Columbus, 8th, 14th, 15th, 16th, 21st, 22d, 23d, 24th, 29th; Canonsburg, 8th, 10th, 16th, 23d; South Eaton, 8th, 24th; York, 23d.

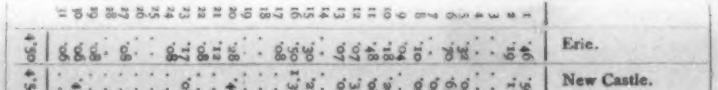
County.	Station	Elevation above Sea Level (feet).	Barometer Reduced to Sea Level.			Temperature.												Relative Humidity.	Dew Point.	Pre	
							Maximum.		Minimum.				Daily Range.								
			Mean.	Highest.	Lowest.	Mean.	Highest.	Date.	Lowest.	Date.	Mean of Maximum.	Mean of Minimum.	Mean	Greatest.	Date	Least.	Date.			Total Inches.	Total Snowfall
Adams,[1]	Gettysburg,	624	. . .	. . .	. . .	39·1	75·0	12	10·0	25	49·1	29·0	20·0	37·0	29	3·0	12	. . .	. . .	2·25	1·0
Allegheny,[1]	Pittsburgh,	847	30·210	30·700	29·600	41·5	71·0	13	11·0	22	50·0	33·0	17·0	39·0	13	6·0	7	83·6	36·8	4·18	. .
Bedford,	Charlesville,	1,300	. . .	. . .	. . .	41·5	73·0	12	8·0	25	49·3	28·5	20·8	43·5	29	8·0	21	74·5	29·0	1·52	. .
Berks,[1]	Reading,	304	30·236	30·658	29·719	38·6	66·0	13	15·0	23	48·1	29·1	19·0	35·0	17	8·0	11	92·9	34·6	3·05	. .
Blair,[2]	Altoona,	1,181	. . .	. . .	. . .	42·6	69·0	13	14·0	29	51·5	33·6	17·9	39·0	14	8·0	5	69·2	33·0	2·17	. .
Blair,	Blue Knob,	2,500	. . .	. . .	. . .	34·1	65·0	2	— 2	22	. . .	. . .	. . .	. . .	. .	. . .	. .	. . .	. . .	2·09	16·0
Blair,	Hollidaysburg,	947	. . .	. . .	. . .	38·7	71·0	2, 12	8·0	29	47·8	27·7	20·1	40·0	29	7·0	7	73·0	31·0	3·04	1·0
Blair,	Tipton,	915	. . .	. . .	. . .	36·9	71·0	12	8·0	22	44·4	30·1	14·3	34·0	18	2·0	7	. . .	. . .	3·52	. .
Bradford,	Wysox,	718	30·206	30·686	29·592	35·3	64·0	13	9·0	23	42·7	26·8	15·9	32·5	29	7·5	7	80·4	29·9	1·99	. .
Bradford,	Le Roy,	1,400	. . .	. . .	. . .	32·9	59·0	13	7·0	22	39·0	27·1	11·9	29·0	13	4·0	11	. . .	. . .	2·01	1·5
Bucks,	Forks of Neshaminy,	. . .	. . .	. . .	. . .	38·9	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. .	. . .	. .	. . .	. . .	2·40	. .
Bucks,	Quakertown,	536	30·210	30·740	29·680	37·3	69·5	12	14·0	23	46·6	27·9	18·7	36·0	12	9·0	11	84·0	31·3	3·19	. .
Cambria,[1]	Johnstown,	1,184	30·255	30·694	29·688	41·3	72·0	12	10·0	22	51·8	30·5	21·3	38·0	13	9·0	30	81·4	36·0	4·97	1·5
Cameron,	Emporium,	1,030	. . .	. . .	. . .	36·4	62·0	12, 13	9·0	25	45·3	26·4	18·9	38·0	25	6·0	21	77·0	29·0	3·80	. .
Carbon,[1]	Mauch Chunk,	550	. . .	. . .	. . .	35·7	64·0	13	12·5	25	44·5	27·0	17·5	34·0	29	7·5	31	. . .	. . .	2·86	1·0
Centre,	State College—Agricultural Experiment Station,	1,191	30·163	30·674	29·560	36·6	65·0	2, 13	7·0	22	45·0	27·6	17·4	35·0	13	5·0	30	84·1	32·3	2·78	. .
Centre,	Phillipsburg,	1,350	. . .	. . .	. . .	35·5	63·0	2	6·0	22	49·6	24·0	25·6	40·0	25	5·0	30	. . .	. . .	2·65	3·5
Chester,	West Chester,	435	30·215	30·660	29·634	39·6	71·5	12	16·0	22	47·5	31·6	15·9	34·5	12	5·5	30	72·0	31·0	2·60	. .
Chester,	Coatesville,	380	. . .	. . .	. . .	38·6	77·0	12	16·0	25	49·3	29·7	19·6	43·0	12	3·0	30	. . .	. . .	2·67	. .
Chester,[1]	Kennett Square,	273	. . .	. . .	. . .	36·7	59·0	13	17·0	22	. . .	. . .	. . .	15·0	25	5·0	30	. . .	. . .	2·37	. .
Chester,	Westtown (17 days),	350	30·139	30·697	29·596	40·4	68·0	12	18·0	22, 25	46·3	32·8	13·5	22·5	29	4·5	30	. . .	. . .	. . .	. .
Clarion,	Rimersburg,	1,500	. . .	. . .	. . .	35·0	61·0	11	6·0	22	41·5	28·9	12·6	34·0	13	4·0	7	. . .	. . .	. . .	4·5
Clarion,	Clarion—State Normal School,	1,530	. . .	. . .	. . .	36·5	66·0	13	6·0	22	43·1	24·3	18·8	39·5	25	5·0	22	86·6	36·5	6·87	. .
Clearfield,	Grampian Hills,	1,450	. . .	. . .	. . .	34·7	60·0	12, 13	6·0	22	41·6	28·2	13·4	32·0	29	4·0	7	. . .	. . .	4·41	5·0
Clinton,	Lock Haven,	560	. . .	. . .	. . .	36·3	66·0	13	12·0	22	42·6	24·1	18·5	36·0	13	8·0	5	. . .	. . .	3·14	1·5
Columbia,	Catawissa,	491	. . .	. . .	. . .	38·0	64·5	13	17·5	22	44·0	31·5	12·5	25·5	2	4·0	7	. . .	. .	2·06	. .
Cumberland,	Carlisle,	480	. . .	. . .	. . .	38·0	68·0	6	15·0	22	47·2	29·6	17·6	34·0	29	7·0	23	84·0	34·0	2·16	. .
Dauphin,[1]	Harrisburg,	361	30·260	30·732	29·706	37·6	67·0	14	15·0	22	38·5	30·5	8·0	32·0	12	5·0	11	80·6	31·8	2·15	. .
Delaware,	Swarthmore—Swarthmore College,	190	30·214	30·614	29·747	40·7	67·0	13	16·0	22	47·9	32·5	15·4	32·0	2	2·4	7	78·6	34·9	1·87	. .
Erie,[1]	Erie,	681	30·150	30·720	29·400	38·0	68·0	12	13·0	22	47·0	29·0	18·0	36·0	11	4·0	7	80·0	30·0	4·50	. .
Fayette,	Uniontown,	1,000	30·208	30·636	29·598	43·2	72·0	11	10·0	22	50·0	33·9	16·1	31·0	1	3·0	7	. . .	. . .	6·10	. .
Forrest,	Tionesta,	1,057	. .	. .	. . .	35·8	72·0	12	10·0	22, 24	45·6	28·4	17·2	35·0	13	3·0	8	80·1	30·0	6·00	4·0
Franklin,[1]	Chambersburg—Wilson Female College (29 days),	618	30·190	30·668	29·671	39·3	73·0	12	11·0	22	50·1	28·1	22·0	44·0	12	6·0	1	78·0	30·4	1·80	. .
Fulton,	McConnellsburg,	875	. . .	. . .	. . .	40·5	74·0	12	13·0	22	50·4	29·8	20·6	40·0	29	7·0	11	75·3	33·3	2·09	. .
Greene,	Waynesburg,	750	. . .	. . .	. . .	41·8	70·0	13	9·0	22	52·2	35·5	16·7	38·0	13	7·0	21	. . .	. . .	3·72	1·0
Huntingdon,[1]	Huntingdon—The Normal College,	650	. . .	. . .	. . .	38·4	72·5	12	11·5	22	48·8	28·0	20·8	39·5	29	3·5	30	. . .	. . .	3·00	. .
Huntingdon,	Petersburg,	700	. . .	. . .	. . .	38·4	70·0	12	8·0	22	45·0	30·8	14·2	27·0	2	3·0	23	. . .	. . .	2·65	. .
Indiana,	Indiana—State Normal School,	1,350	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. .	. . .	. .	. . .	. . .	. . .	. .
Lancaster,	Lancaster (18 days),	413	30·257	30·639	29,566	35·7	58·5	20	15·0	22	44·8	26·9	17·9	30·0	29	10·0	31	80·8	29·9	2·03	. .
Lawrence,	New Castle,	932	. . .	. . .	. . .	39·3	68·0	13	8·0	22	47·3	27·6	19·7	34·0	13	9·0	8	. . .	. . .	4·54	1·5
Lebanon,	Myerstown,	474	30·194	30·645	29·823	36·4	66·1	12	19·6	22	45·9	27·4	18·5	34·7	13	6·0	11	85·2	31·7	2·59	. .
Lebanon,	Annville—Lebanon Valley College,	339	. . .	. . .	. . .	39·4	64·0	6	18·0	22	. . .	. . .	. . .	30·0	29	4·0	23	78·2	33·4	. . .	. .
Lehigh,	Centre Valley,	348	. . .	. . .	. . .	39·4	74·0	12	17·0	22	49·1	32·3	16·8	34·0	12	3·0	7	. . .	. . .	2·45	. .
Lehigh,	Coopersburg,	520	. . .	. . .	. . .	37·8	70·0	12	16·0	22, 23	48·0	29·5	19·4	37·0	12	10·0	10	. . .	. . .	2·88	. .
Lehigh,[1]	Lynnport,	350	. . .	. . .	. . .	35·9	66·0	13	13·0	25	44·8	27·0	17·8	35·0	12	6·0	7	. . .	. . .	2·30	. .
Luzerne,	Drifton—Drifton Hospital,	1,655	. . .	. . .	. . .	34·2	63·0	12	9·0	22	43·5	25·8	17·7	34·0	13	7·0	30	. . .	. . .	1·94	8·7
Luzerne,[1]	Wilkes-Barre,	575	. . .	. . .	. . .	37·5	65·0	13	12·0	22	46·8	28·3	18·5	30·5	17	8·0	31	. . .	. . .	1·97	1·0
Lycoming,[1]	Nisbet,	550	. . .	. . .	. . .	35·6	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. .	. . .	. .	. . .	. . .	3·50	. .
Mercer,[1]	Greenville—Thiel College,	1,000	30·141	30·682	29·471	35·0	66·0	13	6·3	22	45·9	23·8	22·1	42·0	2	10·0	30	92·0	32·8	4·58	11·0
Mifflin,	Lewistown,	500	. . .	. . .	. . .	38·2	65·5	6	13·0	22	47·5	28·5	19·0	36·0	29	6·0	15	79·0	31·9	2·49	1·3
Montgomery,	Pottstown,	150	. .	. .	. . .	39·9	67·0	13	19·0	22	46·0	33·0	13·0	32·0	29	1·0	11	80·0	34·0	2·35	. .
Northampton,	Bethlehem,	360	. . .	. . .	. . .	39·7	67·0	13	17·0	22, 23	46·0	30·0	16·0	32·0	8	8·0	10	79·0	33·0	2·29	1·0
Perry,	New Bloomfield,	400	. . .	. . .	. . .	37·4	67·0	6	10·0	21	46·0	27·8	18·2	34·0	12	6·0	27	. . .	. . .	1·47	. .
Philadelphia,[1]	Philadelphia—Signal Office,	117	30·246	30·760	29·650	41·8	72·0	12	19·0	22, 23	49·4	34·3	15·1	32·0	12	6·0	7	67·6	30·2	1·83	. .
Philadelphia,	Philadelphia—Drexel Building (20 days),	. . .	. . .	. . .	. . .	40·8	. . .	. . .	19·0	22	48·3	33·3	15·0	24.0	22	6·0	10	. . .	. . .	. . .	. .
Potter,	Coudersport,	1,670	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. .	. . .	. .	. . .	. . .	. . .	. .
Schuylkill,	Girardville,	1,000	30·207	30·622	29·793	36·4	64·0	6	14·0	22	44·0	28·0	16·0	32·0	13	6·0	10	. . .	. .	2·94	5·0
Snyder,	Selins Grove (23 days),	445	. . .	. . .	. . .	37·0	66·0	6	14·0	22	46·4	28·6	17·8	40·0	29	7·0	1	86·0	31·3	1·02	. .
Somerset,	Somerset,	2,250	. . .	. . .	. . .	38·0	65·0	12	3·0	22	48·3	26·1	24·2	38·0	25	10·0	8	87·8	32·5	5·60	7·0
Sullivan,	Eagles Mere,	2,060	30·264	30·784	29·749	31·0	57·0	6	5·0	22	36·1	23·0	13·1	24·0	5	3·0	31	82·5	26·2	4·57	8·5
Tioga,	Wellsboro,	1,327	30·149	30·607	29·585	34·9	63·0	2	10·0	22	41·7	28·0	13·7	26·0	18	3·0	7	81·5	29·0	1·98	3·0
Union,[1]	Lewisburg,	450	. . .	. . .	. . .	37·0	65·0	6	15·0	15	44·7	29·3	15·4	28·0	2	7·0	31	. . .	. . .	1·92	. .
Warren,	Columbus,	1,410	. . .	. . .	. . .	34·7	62·0	11, 12	6·0	18, 22	41·2	28·1	13·1	34·0	18	1·0	21	. . .	. . .	5·07	10·0
Washington,	Canonsburg,	950	30·289	30·480	29·444	39·6	69·0	13	8·0	22	48·9	29·7	19·2	41·0	13	4·0	7	73·5	31·0	5·01	7·5
Wayne,	Dyberry,	1,100	. . .	. . .	. . .	31·6	62·0	13	2·0	25	40·6	25·8	14·8	37·0	29	5·0	31	. . .	. . .	2·74	4·5
Wayne,	Honesdale,	1,000	. . .	. . .	. . .	33·0	62·0	13	9·0	25	40·1	25·8	14·3	36·0	29	4·0	7	75·0	30·7	2·29	10·0
Westmoreland,	Greensburg,	1,175	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. .	. . .	. .	. . .	. . .	. . .	. .
Wyoming,[1]	South Eaton	660	. . .	. . .	. . .	35·2	64·0	13	11·0	23	42·9	27·6	15·3	30·0	29	6·0	30	. . .	. . .	1·60	9·0
York,[1]	York,	385	30·154	30·779	29·591	39·9	66·0	12	12·0	22	49·5	29·4	20·1	37·5	13	8·0	21	79·7	31·1	1·84	. .

Observations taken at 8 A. M. and 8 P. M. [2] Observations taken at 12 Noon.

Temperature.									Relative Humidity.	Dew Point.	Precipitation.				Nu
Minimum.		Mean of Maximum.	Mean of Minimum.	Daily Range.											
Lowest.	Date.			Mean.	Greatest.	Date	Least.	Date.			Total Inches.	Total Snowfall During Month.	Depth of Snow on Ground at End of Month.	Number of Days Rainfall.	Clear.
10·0	25	49·1	29·0	20·0	37·0	29	3·0	11	. . .	. . .	2·25	1·00	. . .	13	7
11·0	22	50·0	33·0	17·0	39·0	13	6·0	7	83·6	36·8	4·18	. . .	. . .	18	4
8·0	25	49·3	28·5	20·8	43·5	29	8·0	21	74·5	29·0	1·52	·50	. . .	12	5
15·0	23	48·1	29·1	19·0	35·0	17	8·0	11	92·9	34·6	3·05	. . .	. . .	8	7
14·0	22	51·5	33·6	17·9	39·0	14	8·0	5	69·2	33·0	2·17	. . .	. . .	10	. . .
— 2	22	. . .	. . .	. . .	. . .	. .	. . .	. . .	. . .	. . .	2·09	16·0	. . .	16	26
8·0	22	47·8	27·7	20·1	40·0	29	7·0	7	73·0	31·0	3·04	1·00	. . .	17	8
8·0	22	44·4	30·1	14·3	34·0	18	8·0	7	. . .	. . .	3·52	. . .	. . .	17	9
9·0	23	42·7	26·8	15·9	32·5	29	7·5	7	80·4	29·9	1·99	. . .	. . .	13	6
7·0	22	39·0	27·1	11·9	29·0	13	4·0	11	. . .	. . .	2·01	1·70	. . .	10	3
. .	. . .	. . .	. . .	. . .	. . .	. .	. . .	. . .	. . .	. . .	2·40	. . .	. . .	10	12
4·0	25	46·6	27·9	18·7	36·0	12	9·0	11	84·0	31·3	3·19	. . .	. . .	14	4
0·0	22	51·8	30·5	21·3	38·0	13	9·0	30	81·4	36·0	4·97	1·75	. . .	24	2
9·0	25	45·3	26·4	18·9	38·0	25	6·0	21	77·0	29·0	3·80	·75	. . .	15	5
12·5	25	44·5	27·0	17·5	34·0	29	7·5	31	. . .	. . .	2·86	1·00	. . .	10	11
7·0	22	45·0	27·6	17·4	35·0	13	5·0	30	84·1	32·3	2·58	. . .	. . .	13	3
6·0	22	49·6	24·0	25·6	40·0	25	5·0	30	. . .	. . .	2·65	3·75	. . .	17	5
6·0	22	47·5	31·6	15·9	34·5	19	5·5	30	72·0	31·0	2·60	. . .	. . .	13	11
6·0	25	49·3	29·7	19·6	43·0	12	3·0	30	. . .	. . .	2·67	·10	. . .	14	9
7·0	22	. . .	. . .	. . .	15·0	25	5·0	30	. . .	. . .	2·37	. . .	. . .	10	6
8·0	22, 25	46·3	32·8	13·5	22·5	29	4·5	30	. . .	. . .	. . .	. . .	. . .	. . .	. . .
6·0	22	41·5	28·9	12·6	34·0	13	4·0	7	. . .	. . .	. . .	4·50	. . .	17	4
6·0	22	43·1	24·3	18·8	39·5	25	5·0	22	86·6	36·5	6·87	·75	. . .	11	. . .
6·0	22	41·6	28·2	13·4	32·0	29	4·0	7	. . .	. . .	4·41	5·00	. . .	23	3
2·0	22	44·6	24·1	18·5	36·0	13	8·0	5	. . .	. . .	3·14	1·50	. . .	17	7
7·5	22	44·0	31·5	12·5	25·5	2	4·0	7	. . .	. . .	2·06	. . .	. . .	13	. . .
5·0	22	47·2	29·6	17·6	34·0	29	7·0	23	84·0	34·0	2·16	·50	. . .	13	4
5·0	22	38·5	30·5	8·0	32·0	12	5·0	11	80·6	31·8	2·15	. . .	. . .	14	5
8·0	22	47·9	32·5	15·4	32·0	2	2·4	7	78·6	34·9	1·87	. . .	. . .	8	3
3·0	22	47·0	29·0	18·0	36·0	11	4·0	7	80·0	30·0	4·50	. . .	. . .	22	3
0·0	22	50·0	33·9	16·1	31·0	1	3·0	7	. . .	. . .	6·10	. . .	. . .	13	6
0·0	22, 24	45·6	28·4	17·2	35·0	13	3·0	8	80·1	30·0	6·00	4·00	. . .	10	. . .
1·0	22	50·1	28·1	22·0	44·0	12	6·0	1	78·0	30·4	1·80	. . .	. . .	5	. . .
3·0	22	50·4	29·8	20·6	40·0	29	7·0	11	75·3	33·3	2·09	. . .	. . .	8	10
9·0	22	52·2	35·5	16·7	38·0	13	7·0	21	. . .	. . .	3·72	1·00	. . .	14	4
1·5	22	48·8	28·0	20·8	39·5	29	3·5	30	. . .	. . .	3·00	. . .	. . .	18	10
8·0	22	45·0	30·8	14·2	27·0	2	3·0	23	. . .	. . .	2·65	. . .	. . .	9	7
. .	. . .	. . .	. . .	. . .	. . .	. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
5·0	22	44·8	26·9	17·9	30·0	29	10·0	31	80·8	29·9	2·03	. . .	. . .	. . .	. . .
8·0	22	47·3	27·6	19·7	34·0	13	9·0	8	. . .	. . .	4·54	1·50	. . .	15	5
9·6	22	45·9	27·4	18·5	34·7	13	6·0	11	85·2	31·7	2·59	. . .	. . .	11	8
8·0	22	. . .	. . .	. . .	30·0	29	4·0	23	78·2	33·4	. . .	. . .	. . .	. . .	8
7·0	22	49·1	32·3	16·8	34·0	12	3·0	7	. . .	. . .	2·45	. . .	. . .	13	4
6·0	22, 23	48·9	29·5	19·4	37·0	12	10·0	10	. . .	. . .	2·88	. . .	. . .	12	11
3·0	25	44·8	27·0	17·8	35·0	19	6·0	7	. . .	. . .	2·30	. . .	. . .	. . .	5
9·0	22	43·5	25·8	17·7	34·0	13	7·0	30	. . .	. . .	1·94	2·75	. . .	6	. . .
2·0	22	46·8	28·3	18·5	30·5	17	8·0	31	. . .	. . .	1·97	1·00	. . .	11	10
. .	. . .	. . .	. . .	. . .	. . .	. .	. . .	. . .	. . .	. . .	3·50	. . .	. . .	. . .	. . .
6·3	22	45·9	23·8	22·1	42·0	2	10·0	30	92·0	32·8	4·58	11·00	. . .	20	1
3·0	22	47·5	28·5	19·0	36·0	29	6·0	15	79·0	31·9	2·49	1·35	. . .	16	6
9·0	22	46·0	33·0	13·0	32·0	29	1·0	11	80·0	34·0	2·35	. . .	. . .	6	9
7·0	22, 23	46·0	30·0	16·0	32·0	8	8·0	10	79·0	33·0	2·29	1·00	. . .	8	16
9·0	21	46·0	27·8	18·2	34·0	19	6·0	27	. . .	. . .	1·47	. . .	. . .	10	7
9·0	22, 23	49·4	34·3	15·1	32·0	12	6·0	7	67·6	30·2	1·83	. . .	. . .	11	7
9·0	22	48·3	33·3	15·0	24.0	22	6·0	10	. . .	. . .	. . .	. . .	. . .	. . .	. . .
. .	. . .	. . .	. . .	. . .	. . .	. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
4·0	22	44·0	28·0	16·0	32·0	13	6·0	10	. . .	. . .	2·94	·50	. . .	17	11
4·0	22	46·4	28·6	17·8	40·0	29	7·0	1	86·0	31·3	1·08	. . .	. . .	. . .	. . .
3·0	22	48·3	26·1	22·2	38·0	25	10·0	8	87·8	32·5	5·60	7·00	. . .	14	0
5·0	22	36·1	23·0	13·1	24·0	5	3·0	31	82·5	26·2	4·57	8·25	. . .	15	5
0·0	22	41·7	28·0	13·7	26·0	18	3·0	7	81·5	29·0	1·98	3·00	. . .	17	6
5·0	15	44·7	29·3	15·4	28·0	2	7·0	31	. . .	. . .	1·92	·20	. . .	10	3
6·0	18, 22	41·2	28·1	13·1	34·0	18	1·0	21	. . .	. . .	5·07	10·00	. . .	21	4
8·0	22	48·9	29·7	19·2	41·0	13	4·0	7	73·5	31·0	5·01	·75	. . .	22	6
2·0	25	40·6	25·8	14·8	37·0	29	5·0	31	. . .	. . .	2·74	4·50		13	5
9·0	25	40·1	25·8	14·3	36·0	29	4·0	7	75·0	30·7	2·29	10·00	. . .	. . .	. . .
. .	. . .	. . .	. . .	. . .	. . .	. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
1·0	23	42·9	27·6	15·3	30·0	29	6·0	30	. . .	. . .	1·60	2·00	. . .	15	10
2·0	22	49·5	29·4	20·1	37·5	13	8·0	21	79·7	31·1	1·84	. . .	. . .	11	12

Number of Days Rainfall.	Number of Days.			Wind.			Observers.
				Prevailing Direction.			
	Clear.	Fair.	Cloudy.	7 A. M.	2 P. M.	9 P. M.	
13	7	11	13	S	S	SW	Prof. E. S. Breidenbaugh.
18	4	4	23	NW	NW	NW	Oscar D. Stewart, Sgt. Sig. Corps
12	5	14	12	SW	W	SW	Miss E. A. G. Apple
8	7	9	15	NW	NW	NW	C. M. Dechant, C.E.
10	. . .	. .	. . .	. . .	. . .	. . .	Dr. Charles B. Dudley.
16	3	6	20	NW	NW	NW	A. H. Boyle.
17	8	6	17	W	W	W	Prof. J. A. Stewart.
17	9	10	12	SW	SW	SW	Miss Cora J. Wilson.
13	6	2	23	W	W	W	Charles Beecher.
20	3	9	19	SW	SW	SW	Geo. W. T. Warburton.
20	12	7	12	W	W	W	J. C. Hilsman.
14	4	12	15	NW	SW	SW	J. L. Heacock.
24	2	11	18	S	. . .	SE	E. C. Lorentz.
15	5	4	22	W	W	W	T. B. Lloyd.
10	11	13	7	NW	NW	NW	John J. Boyd.
15	3	8	20	W	W	W	Prof. Wm. Frear.
17	5	3	23	SW	SW	SW	Geo. H. Dunkle.
13	11	7	13	NW	NW	NW	Jesse C. Green, D.D.S.
14	9	9	13	W	S	W	W. T. Gordon.
20	6	9	16	N	N	N	Benj. P. Kirk.
. . .	. . .	. .	. . .	NW	W	W	Prof. Wm. F. Wickersham.
17	4	8	19	W	W	W	Rev. W. W. Deatrick, A.M.
11	. . .	. . .	. . .	SW	SW	SW	C. M. Thomas, B.S.
23	3	6	22	SW	SW	SW	Nathan Moore.
17	7	4	20	W	W	W	Prof. John A. Robb.
13	. . .	. . .	. . .	. . .	. . .	. . .	Robert M. Graham.
13	4	13	14	W	W	W	J. E. Pague.
14	5	10	16	NW	NW	NW	Frank Ridgway, Sgt. Sig. Corps.
8	3	11	17	NW	SW	NW	Prof. Susan J. Cunningham.
22	3	4	24	S	S	S	Peter Wood, Sgt Sig. Corps.
13	6	17	8	. . .	. . .	. . .	Wm. Hunt.
10	. . .	. . .	. . .	SW	SW	SW	R. L. Haslet.
5	. . .	. . .	. . .	. . .	. . .	. . .	Miss Mary A. Ricker.
8	10	8	13	S	W	W	Thomas F. Sloan.
14	4	6	21	. . . .	. . .	. . .	Capt. W. C. Kimber.
18	10	5	16	. . .	. . .	. . .	Prof. W. J. Swigart.
9	7	12	12	W	W	W	J. E. Rooney.
. . .	. . .	. . .	. . .	. . .	. . .	. . .	Prof. S. C. Schmucker.
. . .	. . .	. . .	. . .	NW	NW	SW	E. E. Weller.
15	5	9	17	S	S	S	Wm. T. Butz.
11	8	7	16	W	W	W	Wm. H. Kline.
. . .	8	13	10	NW	NW	SW	Geo. W. Bowman, A.M., Ph.D.
13	4	12	15	NW	NW	NW	H. W. Mullen.
24	11	5	15	SE	SW	SE	M. H. Boye.
. . .	5	13	13	. . .	. . .	. . .	John C. Wuchter.
6	. . .	. . .	. . .	NW	NW	NW	H. D. Miller, M.D.
11	10	1	20	NW	NW	NW	A. W. Betterly.
. . .	. . .	. . .	. . .	. . .	. . .	. . .	John S. Gibson, P. M.
20	1	8	22	SW	. . .	S	Prof. S. H. Miller.
16	6	7	18	NW	NW	NW	Culbertson & Lantz.
6	9	13	9	W	W	W	Charles Moore, D.D.S.
8	16	2	13	NW	NW	NW	Lerch & Rice.
10	7	12	12	W	SW	W	Frank Mortimer.
11	7	9	15	W	W	W	Luther M. Dey, Sgt. Sig. Corps.
. . .	. . .	. . .	. . .	. . .	. . .	. . .	William R. Wallen
. . .	. . .	. . .	. . .	. . .	. . .	. . .	C. L. Peck.
17	11	8	12	NW	NW	NW	E. C. Wagner.
. . .	. . .	. .	. . .	SW	SW	SW	J. M. Boyer,
14	0	9	22	SW	SW	SW	W. M. Schrock.
15	5	8	18	SW	SW	SW	E. S. Chase.
17	6	12	13	S	S	S	H. D. Deming.
10	3	15	13	SW	SW	SW	F. O. Whitman.
21	4	3	24	SW	SW	SW	Wm. Loveland.
22	6	5	20	W	W	W	A. L. Runion, M.D.
13	5	7	19	NW	NW	NW	Theodore Day.
. . .	. . .	. . .	. . .	. . .	. . .	. . .	John Torrey.
. . .	. . .	. . .	. . .	. . .	. . .	. . .	Hilary S. Brunot.
15	10	4	17	S	S	S	Benj. M. Hall.
21	12	8	11	NW	NW	NW	Mrs. L. H. Grenewald.

T. F. Townsend, *Sergeant Signal Corps, Assistant.*



PRECIPITATION FOR JANUARY, 1890.

	Erie.	New Castle.	Greenville.	Columbus.	Pittsburgh.	Uniontown.	Clarion.	Indiana.	Johnstown.	Somerset.	Grampian Hills	Emporium.	Blue Knob.	Phillipsburg.	Petersburg.	Huntingdon.	Hollidaysburg.	Altoona.	Chambersburg.	State College.	York.	Lock Haven.	New Bloomfield.	Wellsboro.	Harrisburg.	Selins Grove.	Lancaster.	Le Roy.	Eagles Mere.	Myerstown.	Wyoox.	Catawissa.	Girardville.	Wilkes-Barre.	South Eaton.	Difton.	Reading.	Pottstown.	West Chester.	Coatesville.	Kennett Square.	Dyberry.	Honesdale.	Quakertown.	Swarthmore.	Philadelphia.	Seisholtzville.	Frederick.	Ottsville.	Smith's Corner.
1	.46	.50	..	.72	.16	..	..	..	.11	..	.40	.55	..	.05	.12	..	.09	.15	..	.17	.28	.27	.14	.10	.12	..	..	.07	.34	.20	.04	.03	.13	.09	.05	..	.10	.07	.11	.07	.08	.16	.08	.11	..	.02	.10	.05	.06	
2	.19	.13	.75	.13	.05	..	..	..	.07	..	.03	.04	..	20	..	.13	..	..	.04	.04	.02	.01	.02	.05	.05	..	..	.09	.42	..	.07	.07	.10	..	.06	..	.04	..	.04	.01	..	..	.06	.02	.01	..	..	..	..	..	
3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
4	..	..	..	..	.05	.12	..	..	.04	..	..	..	..	..	..	.04	.01	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
5	.32	.05	.59	.84	.22	.24	..	..	.56	.25	.41	.40	..	.33	.14	.22	.21	.16	..	.11	.26	.24	.14	.10	.18	..	..	.06	.11	.21	.06	.12	.22	.11	.01	..	.19	.26	.37	.34	.40	.11	.05	.27	.28	.27	.12	.26	.25	
6	.70	.65	.42	.55	.36	1.21	..	..	.24	1.37	.45	.37	..	.15	.09	.07	.12	.08	..	..	.01	.10	..	.06	..	..	..	.03	.22	..	.05	..	.10	.22	.04	..	..	..	.06	.01	.06	.11	.03	.01	.01	.01	..	..	.01	
7	..	.02	..	..	.40	.90	2.00	..	.34	.42	.04	.05	..	.05	.11	.10	.06	..	..	..	.21	..	.04	.05	..	.04	..	..	.51	.09	..	.08	.13	..	.05	..	.07	..	.07	.05	.02	..	..	.07	.07	.09	.25	.07	.04	
8	.10	.02	..	.02	.10	.13	..	..	.05	.05	.05	..	..	.05	..	.03	.05	.02	..	..	..	..	.03	.08	.02	..	..	.02	.03	..	..	..	..	..	..	..	..	..	.03	.01	..	.09	.03	..	..	.02	..	..	.05	
9	.04	..	..	..	..	..	..	..	.02	..	..	..	..	.02	..	..	..	..	..	..	..	..	..	..	..	..	..	.07	..	..	..	..	..	..	.01	..	..	..	..	..	..	.09	..	..	..	..	..	..	..	
10	.18	.20	.15	.14	.20	.25	.20	..	.24	.50	.14	..	..	.02	..	.01	.07	..	..	.02	..	.01	.03	.05	.02	..	..	..	..	..	.09	.05	.11	.08	.04	..	..	..	.15	.11	..	.09	.12	.12	.05	.07	.08	.02	.04	
11	.48	.08	.17	.44	.03	.07	.19	..	.11	..	.23	.48	..	.04	.05	.04	.05	..	..	.02	.01	.11	.04	.16	.08	..	..	.18	.18	..	.26	.08	.09	.15	.22	..	..	..	.05	.01	..	.45	.36	.03	..	..	..	..	..	
12	.07	.37	.09	.07	.15	.03	.38	..	.01	..	.45	.08	..	.10	..	.03	.01	..	..	.12	..	.31	..	.05	.01	..	..	.03	.21	.03	..	..	..	..	.02	..	..	..	..	..	..	..	.02	.02	..	..	..	..	..	
13	.07	.05	..	..	.02	.02	..	..	.01	..	.06	.05	..	.10	..	.06	.06	.02	..	.03	..	.03	..	.08	..	..	..	.05	..	..	.02	..	.03	.06	.02	..	..	..	..	.01	..	..	.03	.09	..	..	..	..	..	
14	..	..	..	.02	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.21	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.07	
15	.30	.25	.90	.30	1.15	1.60	1.80	..	1.54	1.45	.95	.56	..	.75	1.30	1.37	1.27	1.05	1.07	1.17	.90	.73	.60	.26	1.02	..	..	.28	.43	1.16	.42	.57	1.09	.80	.42	..	1.61	1.20	.63	.98	.67	.34	.65	1.38	.50	.31	1.55	1.32	1.54	1.7
16	.50	1.30	.52	.53	.50	.45	.80	..	.32	.10	.28	.40	..	.25	.43	.30	.44	.23	.14	.33	.02	.55	..	.10	.14	..	..	.42	.68	.19	..	.60	.32	.20	.24	..	.26	.25	.21	.31	.20	.50	.12	.36	.26	.32	.38	.28	..	
17	.08	..	.05	.04	..	..	..	..	..	.10	..	..	..	.02	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
18	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
19	..	..	.07	..	.08	..	..	..	.07	.15	..	..	..	..	..	.03	..	..	..	.03	..	.02	..	..	..	..	..	..	..	.01	.03	..	..	.13	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
20	.28	.40	.19	.48	.49	.60	.67	..	.54	.45	.50	.39	..	.30	.39	.31	.37	.37	.30	.26	.21	.30	.17	.36	.14	..	..	.10	.56	.32	..	.16	.09	.13	..	..	.47	.20	.51	.40	.46	.22	.14	.25	.38	.37	..	.31	.21	
21	.12	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.05	.14	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
22	.08	..	.05	.05	..	..	..	..	..	..	.03	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
23	.17	.05	.03	.10	.04	..	.10	..	.04	.15	.06	.05	..	.03	..	.04	.04	..	..	..	.01	..	..	.10	.01	..	..	.02	.21	..	.05	.05	.01	.04	..	..	..	..	.05	.01	..	.12	.09	..	..	.01	..	.03	..	
24	.08	..	.12	.05	..	..	..	..	.07	.16	.08	..	..	..	..	.04	..	..	..	..	..	..	..	..	..	..	..	.05	.30	.02	..	..	.01	..	.01	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
25	..	..	..	..	..	..	..	..	.01	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
26	..	..	.10	.06	..	..	.14	..	.02	.05	.03	..	..	..	..	..	..	..	..	..	..	.16	..	..	..	..	..	..	.02	..	.37	.08	.09	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
27	.08	..	.07	.17	..	..	.09	..	.34	..	.05	.24	..	..	..	.12	.09	.06	..	.06	.02	.06	..	.20	.04	..	..	.21	.15	.02	..	.07	..	.09	.31	..	..	..	..	..	..	.02	.44	.48	.05	..	..	.02	..	
28	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
29	.08	..	.28	.20	.13	..	.50	..	.05	..	.07	..	..	..	.01	.03	.07	..	.25	.09	..	.02	..	.10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
30	.06	.45	.03	.08	.05	.48	..	..	.15	.40	.10	.13	..	.17	..	.06	..	.03	..	.12	.10	.18	.25	.08	.14	..	..	.33	..	.34	..	..	.13	..	.10	..	.31	.37	.32	.35	.37	.09	.07	.42	.32	.34	.46	.32	.42	
31	.06	..	..	.08	..	..	..	..	.02	..	..	.01	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.02	..	..	..	..	..	..	.01	
	4.50	4.54	4.58	5.07	4.18	6.10	6.87	..	4.97	5.60	4.41	3.80	..	2.65	2.65	3.00	3.04	2.17	1.80	2.78	1.84	3.14	1.47	1.98	2.15	..	..	2.01	4.57	2.59	1.99	2.06	2.94	1.97	1.60	..	3.05	2.35	2.60	2.67	2.37	2.74	2.29	3.19	1.87	1.83	2.94	2.68	2.70	2.1

PRECIPITATION FOR JANUARY, 1890.

Harrisburg.	Selins Grove.	Lancaster.	Le Roy.	Eagles Mere.	Myerstown.	Wyson.	Catawissa.	Girardville.	Wilkes-Barre.	South Eaton.	Drifton.	Reading.	Pottstown.	West Chester.	Coatesville.	Kennett Square.	Dyberry.	Honesdale.	Quakertown.	Swarthmore.	Philadelphia.	Seisholtzville.	Frederick.	Ottsville.	Smith's Corner.	Doylestown.	Lansdale.
.12	. .	. .	.07	.34	.20	.04	.03	.13	.09	.05	. .	.10	.07	.11	.07	.08	.16	.08	.11	. .	.02	.10	.03	.06	.14	. .	. .
.05	. .	. .	.09	.42	. .	.07	.07	.16	. .	.08	. .	.04	. .	.04	.01	. .	. .	.02	.01	. .	. .	. .	. .	. .	. .	. .	. .
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.18	. .	. .	.06	.11	.21	.06	.12	.22	.11	.01	. .	.19	.16	.37	.34	.40	.11	.05	.27	.28	.27	.12	.16	.25	.17	.28	.32
. .	. .	. .	.03	.28	. .	.05	. .	.10	.22	.04	. .	. .	. .	.06	.01	.06	.11	.03	.01	.01	.01	. .	. .	.01	. .	. .	. .
.04	. .	. .	. .	.51	.09	. .	.08	.13	. .	.05	. .	.07	. .	.07	.05	.02	. .	. .	.07	.07	.09	.25	.07	.04	.06	.07	.05
.02	. .	. .	.02	.03	. .	. .	. .	. .	. .	. .	. .	. .	. .	.03	.01	. .	.09	.03	. .	. .	.02	. .	. .	.05	. .	. .	. .
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.02	. .	. .	. .	. .	. .	.09	.05	.11	.08	.04	. .	. .	. .	.15	.11	. .	.09	.12	.12	.05	.09	.08	.02	.04	.05	.04	.05
.08	. .	. .	.18	.18	. .	.20	.08	.09	.15	.29	. .	. .	. .	.05	.01	. .	.45	.36	.03	. .	. .	. .	. .	. .	. .	. .	. .
.01	. .	. .	.03	.21	.03	. .	. .	. .	. .	.02	. .	. .	. .	. .	. .	. .	. .	.02	.02	. .	. .	. .	. .	. .	. .	. .	. .
. .	. .	. .	.05	. .	. .	.02	. .	.03	.06	.02	. .	. .	. .	. .	.01	. .	. .	.03	.09	. .	. .	. .	. .	. .	.03	.01	.03
. .	. .	. .	. .	. .	. .	.21	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	.07	. .	.15	. .
.02	. .	. .	.28	.43	1.16	.42	.57	1.09	.80	.42	. .	1.61	1.20	.63	.98	.67	.34	.65	1.38	.50	.31	1.55	1.32	1.54	1.40	.10	.50
.14	. .	. .	.42	.68	.19	. .	.60	.32	.20	.24	. .	.26	.25	.21	.31	.20	.50	.12	.36	.26	.32	.38	.28	. .	.34	. .	.70
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
. .	. .	. .	. .	. .	.01	.03	. .	.13	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
.14	. .	. .	.10	.56	.32	. .	.16	.09	.13	. .	. .	.47	.20	.51	.40	.46	.22	.14	.25	.38	.37	. .	.31	.21	.24	.34	.32
.14	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
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.01	. .	. .	.02	.21	. .	.05	.05	.01	.04	. .	. .	. .	. .	.05	.01	. .	.12	.09	. .	. .	.01	. .	.03	. .	.02	. .	. .
. .	. .	. .	.05	.30	.02	. .	. .	.01	. .	.01	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
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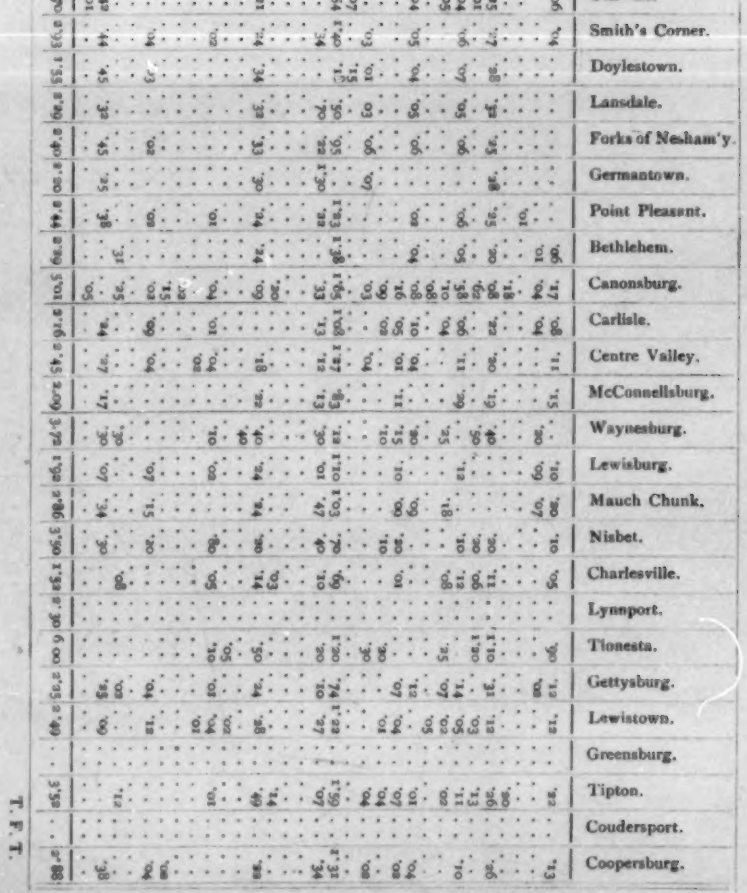
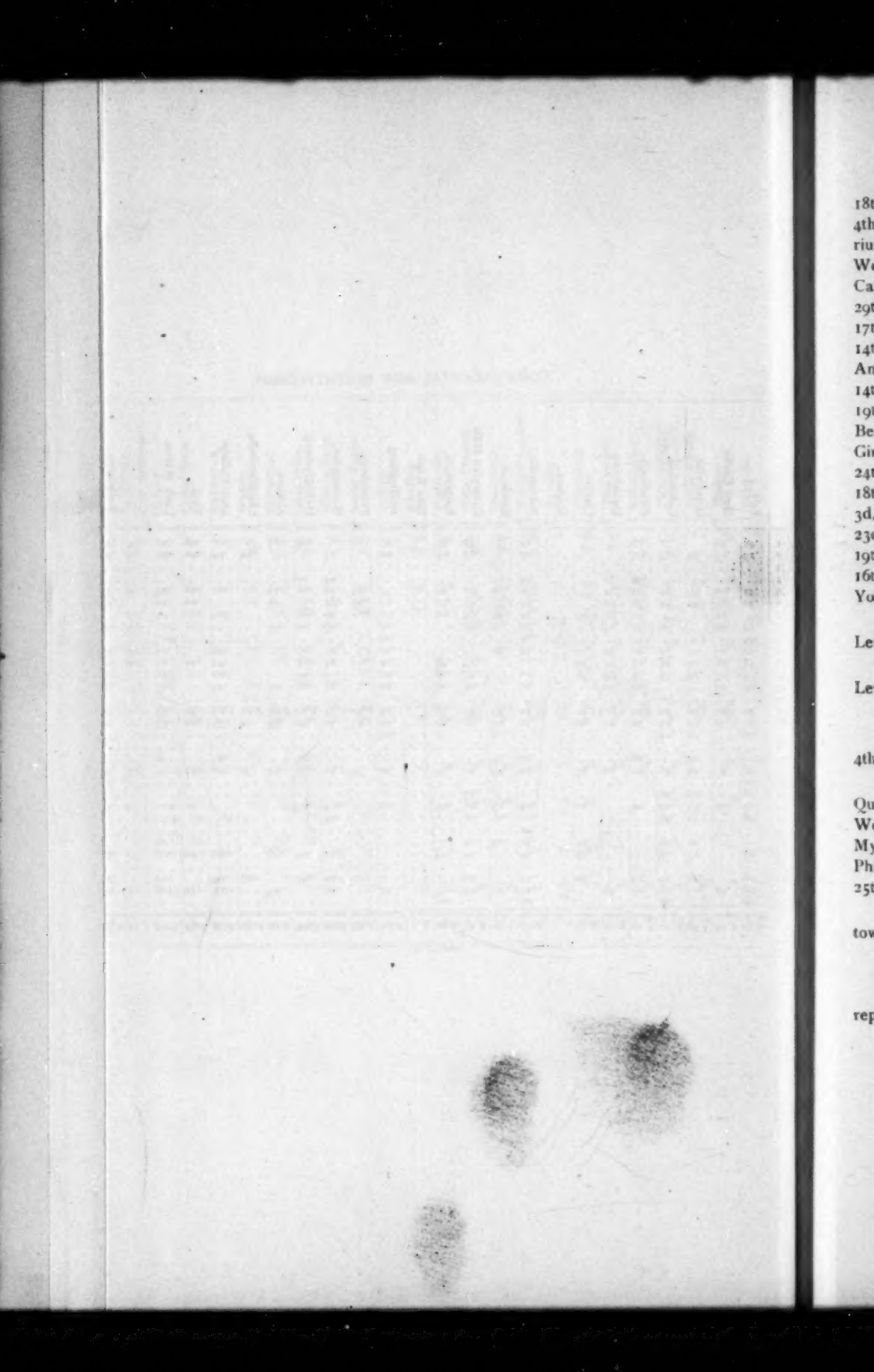
. .	. .	. .	. .	.02	. .	.37	.08	.09	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
.04	. .	. .	.21	.35	.02	. .	.07	. .	.09	.31	. .	. .	. .	. .	. .	.02	.44	.48	.05	. .	. .	. .	.02	. .	.04	.03	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
. .	. .	. .	. .	. .	. .	.32	.10	.10	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
.14	. .	. .	.33	. .	.34	. .	. .	.13	. .	.10	. .	.31	.37	.32	.35	.37	.09	.07	.42	.32	.34	.46	.32	.42	.44	.45	.32
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	.02	. .	. .	. .	. .	. .	. .	.01	. .	. .	. .
.15	. .	. .	2.01	4.57	2.59	1.99	2.06	2.94	1.97	1.60	. .	3.05	2.35	2.60	2.67	2.37	2.74	2.29	3.19	1.87	1.83	2.94	2.68	2.70	2.93	1.55	2.29


Smith's Corner.
Doylestown.
Lansdale.
Forks of Nesham'y.
Germantown.
Point Pleasant.
Bethlehem.
Canonsburg.
Carlisle.
Centre Valley.
McConnellsburg.
Waynesburg.
Lewisburg.
Mauch Chunk.
Nisbet.
Charlesville.
Lynnport.
Tionesta.
Gettysburg.
Lewistown.
Greensburg.
Tipton.
Coudersport.
Coopersburg.

T. F. T.



Frost.—Gettysburg, 18th, 19th, 29th, 31st; Blue Knob, 3d, 4th, 14th, 17th, 18th, 22d, 25th, 29th, 31st; Hollidaysburg, 4th, 14th, 19th, 25th, 29th; Tipton, 4th, 18th, 25th; Quakertown, 4th, 17th, 18th, 19th, 25th, 28th, 29th; Emporium, 4th, 18th, 19th, 29th; State College, 18th, 19th, 29th; Phillipsburg, 4th; Westtown, 4th, 20th; Grampian Hills, 4th, 18th, 29th; Lock Haven, 3d, 4th; Catawissa, 3d, 4th, 18th, 19th, 21st, 25th, 28th, 29th; Carlisle, 18th, 19th, 29th; Uniontown, 29th,; Chambersburg, 17th, 18th, 29th; Huntingdon, 14th, 17th, 18th, 22d, 25th, 28th; Petersburg 4th, 17th, 18th, 19th; Lancaster, 14th, 19th, 29th; New Castle, 4th, 9th, 14th, 17th, 18th, 22d, 23d, 25th Annville, 18th, 19th, 20th, 29th; Coopersburg, 1st, 4th, 9th, 10th, 11th, 14th, 16th, 17th, 18th, 19th, 21st, 22d, 23d, 24th, 25th, 28th, 29th; Nisbet, 19th, 28th; Greenville, 4th; Lewistown, 4th, 18th, 19th 35th, 28th, 29th; Bethlehem, 4th, 8th, 19th, 25th, 29th; New Bloomfield, 4th, 19th, 29th; Girardville, 1st, 4th, 5th, 8th, 9th, 10th, 11th, 14th, 17th, 19th, 21st, 23d, 24th, 25th, 28th, 29th; Wellsboro, 1st, 3d, 4th, 8th, 9th, 10th, 14th, 17th, 18th, 19th, 21st, 22d, 23d, 24th, 25th, 28th, 29th, 30th; Columbus, 1st, 3d, 4th, 7th, 8th, 9th, 10th, 11th, 14th, 15th, 16th, 17th, 18th, 19th, 21st, 22d, 23d, 24th, 25th, 28th, 29th; Canonsburg, 4th, 28th 29th; Dyberry, 4th, 18th, 19th, 29th; South Eaton, 1st, 3d, 4th, 5th 8th, 9th, 10th, 11th, 14th, 15th, 16th, 17th, 18th, 19th, 21st, 22d, 23d, 24th, 25th, 27th, 28th, 29th, 30th; York, 4th, 9th, 18th, 19th, 25th.

Sleet.—Charlesville, 7th; Blue Knob, 14th 30th; Grampian Hills, 15th; Lewistown, 16th; New Bloomfield, 21st; Dyberry, 11th, 15th.

Coronæ.—Charlesville, 3d, 5th; Tipton 2d, 3d; Greenville, 3d, 27th; Lewistown, 30th; Dyberry, 2d, 4th, 8th, 28th.

Aurora.—Le Roy, 17th; Eagles Mere, 17th.

Solar Halos.—Le Roy, 25th; Annville, 25; Eagles Mere, 25th; Wellsboro, 4th; Dyberry, 18th.

Lunar Halos.—Gettysburg, 3d, 5th; Wysox, 31st; Le Roy, 2d, 4th, 7th; Quakertown, 3d; State College, 3d; West Chester, 3d; Coatesville, 3d; Westtown, 3d; Carlisle, 3d, 5th; Uniontown, 3d; Chambersburg, 29th, 30th; Myerstown, 3d; Centre Valley, 3d; Greenville, 2d; Lewistown, 2d, 3d; Philadelphia, 3d, 29th; Girardville, 3d; Somerset, 4th; Eagles Mere, 2d, 25th; Wellsboro, 4th, 25th.

Meteors.—Catawissa, 14th; Annville, 18th; Wilkes-Barre, 14th; Lewistown, 14th; Eagles Mere, 24th.

WEATHER FORECASTS.

Percentage of local verifications of weather and temperature signals as reported by displaymen for January, 1890:

Weather, 85 per cent.

Temperature, 83 per cent.

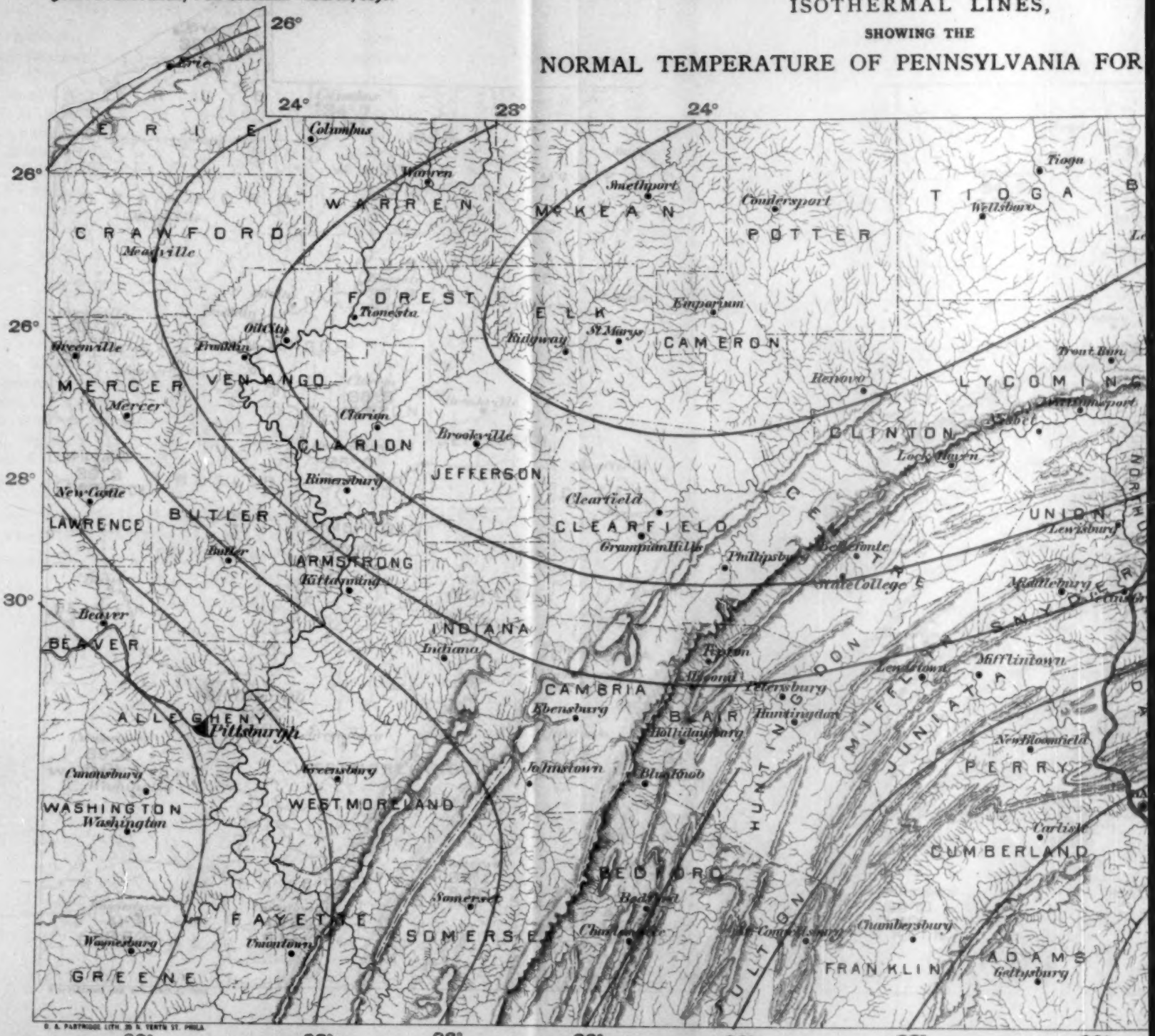
TEMPERATURE AND WEATHER SIGNAL DISPLAY STATIONS.

Displayman.	*Station.*
U. S. Signal Office,	Philadelphia.
Wanamaker & Brown,	"
Pennsylvania Railroad Company,	"
Continental Brewing Company,	"
Samuel Simpson,	"
B. T. Babbitt,	"
Western Meat Company,	"
Neptune Laundry,	"
C. W. Burkhart,	Shoemakersville.
A. N. Lindenmuth,	Allentown.
C. B. Whitehead,	Bradford.
Capt. Geo. R. Guss,	West Chester.
Thomas F. Sloan,	McConnellsburg.
J. H. Fulmer,	Muncy.
W. T. Butz,	New Castle.
Capt. A. Goldsmith,	Quakertown.
Postmaster,	Meadville.
Frank Ross,	Oil City.
Lerch & Rice,	Bethlehem.
John W. Aitken,	Carbondale.
Signal Office,	Erie.
J. R. Raynsford,	Montrose.
E. P. Wilbur & Co.,	South Bethlehem.
Agricultural Experiment Station,	State College.
Signal Office,	Pittsburgh.
New Era,	Lancaster.
State Normal School,	Clarion.
Clarion Collegiate Institute,	Rimersburg.
Thiel College,	Greenville.
D. G. Hurley,	Altoona.
J. E. Forsythe,	Butler.
James H. Fones,	Tionesta.
Steward M. Dreher,	Stroudsburg.
State Normal School,	Millersville.
E. C. Wagner,	Girardville.
Hartford P. Brown,	Rochester.
L. H. Grenewald,	York.
J. E. Pague,	Carlisle.
C. L. Peck,	Coudersport.
H. D. Miller,	Drifton.
M. Tannehill,	Confluence.
S. C. Burkholder,	Pollock.
Robt. M. Graham,	Catawissa.
Henry F. Bitner,	Millersville.

ISOTHERMAL LINES,

SHOWING THE

NORMAL TEMPERATURE OF PENNSYLVANIA FOR



D. A. PARTRIDGE LITH. 20 S. TENTH ST. PHILA

Displayman.	*Station.*
A. M. Wildman,	Langhorne.
G. W. Klee,	Chambersburg.
A. Simon's Sons,	Lock Haven.
J. K. M. McGowan,	Lock No. 4.
Raftsman's Journal,	Clearfield.
W. S. Ravenscroft,	Hyndman.
R. C. Schmidt & Co.,	Belle Vernon.
H. W. Mullen,	Centre Valley.
Chas. B. Lutz,	Bloomsburg.
E. C. Lorentz,	Johnstown.
W. M. James,	Ashland.
Miller & Allison,	Punxsutawney.
Dr. A. L. Runion,	Canonsburg.
E. J. Sellers,	Kutztown.
T. F. Heebner,	Scranton.
H. J. Fosnot,	Lewistown.
H. M. Kaisinger,	Hartsville.
F. Jennet,	Franklin.
Milton C. Cooper,	Ashbourne.
Geo. W. Bowman,	Annville.
P. S. Weber,	DuBois.
Foulk & Co.,	Milford.
William Lawton,	Wilmington, Del.

Errata.—December review, 1889. Precipitation, Grampian Hills, May "1·60" should be 11·60. Annual "43·58" should be "53·58."

First page, last line, "above," should be normal.

PENNSYLVANIA STATE WEATHER SERVICE.

MONTHLY WEATHER REVIEW

FOR FEBRUARY, 1890.

Prepared under the Direction of the Committee on Meteorology of the FRANKLIN INSTITUTE.

HALL OF THE FRANKLIN INSTITUTE,
PHILADELPHIA, February 28, 1890.

TEMPERATURE.

The mean temperature of 64 stations for February, 1890, was 37°.1, which is about 8° above the normal, and 14° above the corresponding month of 1889. The mean of the daily maximum and minimum temperatures 45°.7 and 28°.2 give an average daily range of 17°.5, and a monthly mean of 37°.0.

Highest monthly means, 42°.1 at Uniontown, and 41°.4 at Philadelphia.

Lowest monthly means, 30°.2 at Dyberry, and 32°.2 at Le Roy.

Highest and lowest temperature recorded during the month, 79°.0 at New Bloomfield, on the 26th, and zero at Dyberry, on the 23d.

Greatest local monthly range, 24°.7 at Phillipsburg.

Least local monthly range, 11°.1 at Swarthmore.

Greatest daily range, 42° at Dyberry, and Honesdale on the 23d.

Least daily range, 2° at Le Roy, 19th; Rimersburg, 15th; Annville, 4th, and Columbus, 12th.

BAROMETER.

The mean pressure for the month was 30.10, which is nearly normal.

The highest observed was 30.606 at Philadelphia on the 7th, and the lowest 29.485, on the 14th, at Greenville.

PRECIPITATION.

The average rainfall [including melted snow] was 4.32 inches for 62 stations. This is nearly normal, and the distribution was evenly divided.

While the snowfall was light, it was greater during February than in any of the past winter months. Several stations report snow on the 1st, 2d, 7th, 8th, 9th, 11th, 19th, 20th, 21st and 22d. The average total depth for 54 stations was 5.56 inches. Owing to the warm weather, it remained on the ground but a short time.

WIND AND WEATHER.

The prevailing wind was from the west.

The weather was unusually warm, and all early vegetation was brought forward to a very advanced stage. Winter grain is reported in an excellent condition and uninjured by frosts.

MISCELLANEOUS PHENOMENA.

Thunder-storms.—Gettysburg, 18th; Blue Knob, 4th, 18th, 24th, 28th; Quakertown, 18th; Johnstown, 20th and 24th; Coatesville, 18th; Kennett Square, 18th; Westtown, 18th; Carlisle, 10th; Swarthmore, 18th; Uniontown, 18th, 19th, 27th; Chambersburg, 18th; McConnellsburg, 18th; Indiana, 18th, 20th; Lancaster 18th; Annville, 18th; Centre Valley, 18th; Greenville, 2d, 8th, 14th; Pottstown, 18th; Bethlehem, 18th; New Bloomfield, 18th; Philadelphia, 18th; Girardville, 18th; Somerset, 18th, 24th, 25th; Wellsboro, 18th; Columbus, 25th; Cannonsburg, 19th, 24th, 25th; Dyberry, 18th; Honesdale, 19th, 24th; York, 18th; Hulmeville, 18th.

Hail.—Blue Knob, 7th, 17th, 18th, 19th; West Chester, 19th; Lock Haven, 7th; Myerstown, 19th; Annville, 18th; Nisbet, 20th; Girardville, 7th; Somerset, 14th; Wellsboro, 19th; Hulmeville, 18th.

Snow.—Gettysburg, 1st, 2d, 7th, 20th; Charlesville, 2d, 7th; Reading, 8th, 21st; Altoona, 2d, 8th; Blue Knob, 1st, 2d, 6th, 7th, 8th, 9th, 15th, 20th, 21st, 22d; Hollidaysburg, 1st, 7th; Wysox, 8th, 9th, 19th; Le Roy, 7th, 8th, 20th; Quakertown, 2d. 3d, 7th, 8th, 9th, 11th, 20th; Johnstown, 1st, 2d, 7th, 8th, 9th, 20th, 22d; Emporium, 2d, 8th, 20th, 21st, 22d; Mauch Chunk, 7th, 8th, 20th, 21st; State College, 2d, 7th, 8th, 21st; Phillipsburg, 1st, 7th, 8th, 20th, 21st; West Chester, 1st, 2d, 19th; Coatesville, 2d, 8th, 20th; Kennett Square, 1st, 2d, 11th; Westtown, 1st, 2d, 7th, 20th; Rimersburg, 1st, 7th, 8th, 21st; Lock Haven, 2d, 7th, 8th, 20th; Catawissa, 2d, 7th, 8th, 20th; Carlisle, 2d, 7th, 20th; Swarthmore, 2d; Uniontown, 1st, 7th, 8th, 20th; Chambersburg, 1st, 7th; McConnellsburg, 1st, 8th; Waynesburg, 7th, 8th; Huntingdon, 1st, 2d, 7th; Petersburg, 1st, 2d, 7th, 8th, 19th, 20th, 21st, Indiana, 7th, 8th, 9th, 20th; Lancaster, 1st, 2d, 7th, 19th, 20th; New Castle, 1st, 7th, 8th, 9th; Myerstown, 1st, 2d, 7th, 8th; Annville, 2d, 7th, 8th, 11th, 20th; Centre Valley, 2d, 7th, 8th, 11th, 20th; Coopersburg, 2d, 8th, 20th; Lynnport, 2d, 8th, 20th; Wilkes-Barre, 7th, 8th; Nisbet, 2d, 7th, 8th; Greenville, 2d, 6th, 7th, 8th, 9th, 12th, 21st, 22d; Lewistown, 2d, 7th, 8th, 20th, 21st; Pottstown, 2d; Bethlehem, 1st, 2d, 7th, 8th, 11th, 19th; New Bloomfield, 1st, 19th; Philadelphia, 1st, 2d, 19th; Coudersport, 8th, 20th, 21st, 22d; Girardville, 2d, 7th, 8th, 19th, 20th; Somerset, 1st, 8th, 9th, 20th; Eagles Mere, 7th, 8th, 20th, 21st; Lewisburg, 2d, 8th, 20th, 22d; Columbus, 8th, 15th, 21st; Cannonsburg, 1st, 7th, 8th; Dyberry, 7th, 8th, 20th; Honesdale, 1st, 7th; Greensburg, 1st, 7th, 8th, 20th; South Eaton, 7th, 8th, 20th; York, 1st, 2d, 7th; Hulmeville, 1st, 19th.

Frost.—Gettysburg, 7th, 12th, 13th, 17th, 22d; Charlesville, 12th, 17th; Blue Knob, 1st, 6th, 7th, 10th, 11th, 13th, 16th, 21st, 22d; Hollidaysburg,

Monthly Summary of Reports by Voluntary Observers of the Pennsylvania State Weather Ser

County.	Station.	Elevation above Sea Level (feet).	Barometer Reduced to Sea Level.			Temperature.												Relative Humidity.	Dew Point.	Precipi	
							Maximum.		Minimum.				Daily Range.								
			Mean.	Highest.	Lowest.	Mean.	Highest.	Date.	Lowest.	Date.	Mean of Maximum.	Mean of Minimum.	Mean.	Greatest.	Date.	Least.	Date.			Total Inches.	Total Snowfall During Month.
Adams,[1]	Gettysburg,	624	. . .	. . .	. . .	37·8	72·0	18	19·0	7, 10	46·7	29·0	17·7	33·0	13	3·0	28	. . .	. . .	4·31	11·50
Allegheny,[1]	Pittsburgh,	847	30·080	30·460	29·560	42·0	68·0	4	16·0	21	50·4	33·4	17·0	31·0	11	7·0	9	76·5	35·0	5·52	2·25
Bedford,	Charlesville,	1,300	. . .	. . .	. . .	36·6	67·0	26	6·0	10	48·4	25·4	23·0	40·0	4	5·0	2	81·9	31·5	2·81	2·00
Berks,[1]	Reading,	304	30·162	30·571	29·732	37·2	57·0	19	17·0	7	45·6	28·9	16·7	37·0	18	8·0	4	94·3	33·7	4·05	2·50
Blair,[2]	Altoona,	1,181	. . .	. . .	. . .	41·6	66·0	19	15·0	10	49·8	33·5	16·3	30·0	19	8·0	24	67·1	30·0	4·09	. . .
Blair,	Blue Knob,	2,500	. . .	. . .	. . .	33·8	62·0	25	7·0	24	40·3	27·2	13·1	. . .	. . .	. . .	. . .	. . .	. . .	3·66	31·00
Blair,	Hollidaysburg,	947	. . .	. . .	. . .	37·3	68·0	18	4·0	10	47·5	26·3	21·2	38·0	13	9·0	28	82·5	33·0	4·76	6·80
Blair,	Tipton,	915	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Bradford,	Wysox,	718	30·113	30·574	29·549	34·2	63·0	5	9·8	7	42·8	23·6	19·2	33·0	5	4·5	19	77·7	27·8	2·46	2·00
Bradford,	Le Roy,	1,400	. . .	. . .	. . .	32·2	57·0	5, 18	6·0	7	39·0	24·8	14·2	30·0	5	2·0	13	. . .	. . .	2·96	8·00
Bucks,	Forks of Neshaminy,	. . .	. . .	. . .	. . .	38·2	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	4·28	. . .
Bucks,	Quakertown,	536	30·130	30·580	29·570	36·4	69·2	18	14·7	7	46·3	27·9	18·4	32·0	5	7·0	28	80·0	29·9	5·18	1·50
Bucks,	Hulmeville,	120	30·070	30·640	29·490	33·7	67·0	26	14·0	7, 14	43·2	26·6	16·6	34·0	18	0·0	28	. . .	. . .	3·83	3·00
Cambria,[1]	Johnstown,	1,184	30·142	30·570	29·570	40·4	67·0	5, 26	12·0	10	51·0	30·0	21·0	33·0	13	8·0	9	83·4	33·4	5·05	7·05
Cameron,	Emporium,	1,030	. . .	. . .	. . .	36·1	65·0	5	7·0	10	46·3	24·7	21·6	32·0	5	6·0	9	. . .	. . .	5·02	8·60
Carbon,[1]	Mauch Chunk,	550	. . .	. . .	. . .	36·0	67·0	18	14·0	7	45·0	27·0	18·0	35·5	18	6·0	28	. . .	. . .	5·36	3·00
Centre,	State College—Agricultural Experiment Station,	1,191	30·059	30·548	29·501	35·4	69·0	4	10·0	9	44·0	26·3	17·7	38·0	5	7·0	28	85·2	31·5	4·31	4·65
Centre,	Phillipsburg,	1,350	. . .	. . .	. . .	34·6	63·0	5, 26	4·0	10	47·8	23·1	24·7	44·0	13	13·0	14	. . .	. . .	5·14	6·50
Chester,	West Chester,	455	30·133	30·580	29·534	39·0	69·0	18	18·0	7	47·8	31·1	16·7	27·0	5	6·5	24	72·0	30·0	5·41	3·00
Chester,	Coatesville,	380	. . .	. . .	. . .	38·2	73·0	18	18·0	11	49·6	29·8	19·8	35·0	18	7·0	28	. . .	. . .	4·88	. . .
Chester,[1]	Kennett Square,	275	. . .	. . .	. . .	37·6	59·0	5	18·0	7	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	4·74	. . .
Chester,	Westtown,	350	. . .	. . .	. . .	40·1	69·5	18	19·0	7	47·6	29·7	17·9	26·0	5	6·5	24	. . .	. . .	2·39	3·00
Clarion,	Rimersburg,	1,500	. . .	. . .	. . .	34·2	63·0	4	5·0	21	41·1	27·4	13·7	31·0	5	2·0	15	. . .	. . .	. . .	6·00
Clarion,	Clarion—State Normal School,	1,530	. . .	. . .	. . .	34·8	69·0	5	8·0	10	44·4	24·8	19·6	36·0	5	8·0	9	86·1	31·0	4·78	6·95
Clearfield,	Grampian Hills,	1,450	. . .	. . .	. . .	33·9	60·0	18, 25	12·0	10, 29	44·0	26·5	15·5	34·0	13	4·0	14	. . .	. . .	5·52	9·00
Clinton,	Lock Haven,	560	. . .	. . .	. . .	35·0	68·0	18	12·0	11	43·4	26·1	17·1	35·0	18	6·0	28	. . .	. . .	4·04	6·10
Columbia,	Catawissa,	491	. . .	. . .	. . .	38·0	62·0	5	18·0	7	44·5	31·5	13·0	. . .	. . .	. . .	. . .	. . .	. . .	3·41	9·00
Cumberland,	Carlisle,	480	. . .	. . .	. . .	37·7	72·0	18	19·0	10	46·3	29·7	16·6	39·0	18	5·0	2	84·5	33·0	4·12	6·00
Dauphin,[1]	Harrisburg,	361	30·130	30·525	29·592	37·6	74·0	5	18·0	7	44·6	30·7	13·9	36·0	5	4·0	15	77·4	32·6	3·39	. . .
Delaware,	Swarthmore—Swarthmore College,	190	30·090	30·527	29·695	40·2	68·5	18	21·0	7, 21	44·2	33·1	11·1	27·8	5	6·0	1	80·0	34·0	3·93	1·00
Erie,[1]	Erie,	681	30·000	30·510	29·580	35·0	67·0	4	14·0	21	43·0	27·0	16·0	39·0	4	5·0	6	84·0	29·0	3·60	. . .
Fayette,	Uniontown,	1,000	30·098	30·473	29·543	42·1	66·0	4, 18	19·0	22	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	4·73	2·00
Forrest,	Tionesta,	1,057	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Franklin,[1]	Chambersburg—Wilson Female College,	618	30·161	30·542	29·733	37·9	72·0	18	15·0	10	48·2	27·7	20·5	36·0	18	9·0	8	86·2	28·0	3·90	6·50
Fulton,	McConnellsburg,	875	. . .	. . .	. . .	39·2	71·0	18	16·0	10	49·0	29·2	19·8	33·0	18	9·0	28	78·6	32·7	4·00	4·50
Greene,	Waynesburg,	750	. . .	. . .	. . .	40·5	66·0	5, 18	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	5·19	. . .
Huntingdon,[1]	Huntingdon—The Normal College,	650	. . .	. . .	. . .	37·7	68·5	18	7·5	10	48·5	26·9	21·6	37·5	13	9·5	2	. . .	. . .	5·18	. . .
Huntingdon,	Petersburg,	700	. . .	. . .	. . .	35·5	69·0	18	9·0	10	42·4	28·4	14·0	33·0	13	6·0	15	. . .	. . .	4·98	5·50
Indiana,	Indiana—State Normal School,	1,350	30·098	30·488	29·644	38·5	64·0	4, 25	11·0	21	47·2	31·1	16·1	36·5	5	7·5	1	79·8	32·6	5·89	3·00
Lancaster,	Lancaster,	411	30·108	30·530	29·682	38·8	69·5	18	15·0	21	47·9	26·9	21·0	33·0	19	12·0	9	80·0	32·7	3·14	3·00
Lawrence,	New Castle,	932	. . .	. . .	. . .	40·9	63·0	4, 28	12·0	21	48·8	29·1	19·7	34·0	28	7·0	7	. . .	. . .	6·39	5·37
Lebanon,	Myerstown,	474	30·076	30·478	29·656	36·8	69·5	18	15·0	7	44·7	27·8	16·9	37·5	18	9·0	28	83·1	32·0	3·78	1·50
Lebanon,	Annville—Lebanon Valley College,	339	. . .	. . .	. . .	39·5	73·0	26	29·0	7	. . .	. . .	. . .	36·0	18	2·0	4	84·9	35·2	. . .	. . .
Lehigh,	Centre Valley,	348	. . .	. . .	. . .	40·2	71·0	18, 26	20·0	7, 21	48·9	33·5	15·4	34·0	18	3·0	4	. . .	. . .	3·34	. . .
Lehigh,	Coopersburg,	520	. . .	. . .	. . .	37·2	68·0	18	17·0	7, 21	48·6	29·4	19·2	37·0	5	8·0	28	. . .	. . .	5·32	1·50
Lehigh,[1]	Lynnport,	350	. . .	. . .	. . .	36·2	68·0	18, 19	12·0	7	45·5	26·9	18·6	38·0	19	7·0	2	. . .	. . .	5·00	. . .
Luzerne,	Drifton—Drifton Hospital,	1,655	. . .	. . .	. . .	33·6	63·0	18	11·0	7	42·7	25·5	17·2	28·0	5	7·0	1	. . .	. . .	3·60	6·00
Luzerne,[1]	Wilkes-Barre,	575	. . .	. . .	. . .	37·0	66·5	26	12·0	7, 21	47·0	27·0	20·0	35·0	19	10·0	28	. . .	. . .	3·00	2·00
Lycoming,[1]	Nisbet,	550	. . .	. . .	. . .	35·7	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	3·70	6·00
Mercer,[1]	Greenville—Thiel College,	1,000	30·031	30·471	29·485	35·8	63·5	5	12·1	21	45·0	26·6	18·4	36·5	5	6·0	3	89·1	30·9	5·05	5·00
Mifflin,	Lewistown,	500	. . .	. . .	. . .	37·9	71·5	18	15·5	10	48·1	28·2	19·9	36·0	18	10·0	4	77·8	31·3	4·16	5·30
Montgomery,	Pottstown,	150	. . .	. . .	. . .	39·8	71·0	18	19·0	7	48·0	33·4	14·6	30·0	18	7·0	28	75·6	34·0	4·81	2·00
Northampton,	Bethlehem,	360	30·065	30·511	29·534	40·0	68·0	13, 19	17·0	7	47·0	30·5	16·5	36·0	18	7·0	28	78·0	33·0	4·67	2·00
Perry,	New Bloomfield,	400	. . .	. . .	. . .	36·7	79·0	26	16·0	7	43·9	29·5	14·4	39·0	26	4·0	27	. . .	. . .	6·11	4·70
Philadelphia,[1]	Philadelphia—Signal Office,	117	30·132	30·606	29·608	41·4	69·0	18, 26	21·0	7, 21	49·0	33·9	15·1	26·0	8	7·0	19	74·0	31·4	3·39	. . .
Potter,	Coudersport,	1,670	. . .	. . .	. . .	34·3	60·0	26	1·0	11	41·3	25·4	15·9	34·0	11	7·0	15	89·5	29·3	5·90	8·00
Schuylkill,	Girardville,	1,000	30·114	30·445	29·669	35·8	64·0	18	15·0	7	43·0	27·0	16·0	27·0	16	8·0	24	. . .	. . .	4·56	6·00
Snyder,	Selins Grove,	445	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Somerset,	Somerset,	2,250	. . .	. . .	. . .	36·8	65·0	4	10·0	10, 21	46·4	28·9	17·5	34·0	5	6·0	14	82·1	32·5	4·51	8·00
Sullivan,	Eagles Mere,	2,000	30·149	30·632	29·551	30·4	55·0	26	8·0	21	35·6	22·5	13·1	27·0	5	4·0	28	77·8	24·0	6·20	13·50
Tioga,	Wellsboro,	1,327	30·056	30·535	29·493	33·8	62·0	18	4·0	11	42·9	25·7	17·2	40·0	13	5·0	28	74·3	26·0	2·28	11·50
Union,[1]	Lewisburg,	450	. . .	. . .	. . .	36·9	66·0	18	16·0	7	44·9	29·0	15·9	32·0	18	8·0	28	. . .	. . .	3·89	3·40
Warren,	Columbus,	1,410	. . .	. . .	. . .	33·9	62·0	24	2·0	11	42·1	25·7	16·4	30·0	11	2·0	12	. . .	. . .	4·68	6·00
Washington,	Canonsburg,	950	. . .	. . .	. . .	39·0	68·0	5	13·0	10	51·3	28·5	22·8	40·0	11	10·0	3	77·2	32·3	5·55	2·25
Wayne,	Dyberry,	1,100	. . .	. . .	. . .	30·2	60·0	26	0	23	40·0	21·4	18·6	42·0	23	5·0	28	. . .	. . .	3·74	7·50
Wayne,	Honesdale,	1,000	. . .	. . .	. . .	33·2	59·0	26	3·0	23	41·4	23·0	16·4	42·0	23	4·0	6	72·8	29·6	3·19	8·00
Westmoreland,	Greensburg (26 days),	1,175	. . .	. . .	. . .	42·5	68·0	25	15·5	22	52·4	31·7	20·7	32·0	13	8·0	9	76·2	35·7	4·41	2·00
Wyoming,[1]	South Eaton	660	. . .	. . .	. . .	34·8	63·0	18	9·0	7	43·6	26·1	17·5	32·0	19	7·0	28	. . .	. . .	3·09	7·00
York,[1]	York,	385	30·055	30·373	29·620	39·1	69·5	26	19·0	7	48·2	30·1	18·1	33·5	26	11·0	24	79·5	31·5	2·85	1·50

Observations taken at 8 A. M. and 8 P. M. [2] Observations taken at 12 Noon.

Temperature.									Relative Humidity.	Dew Point.	Precipitation.			
Minimum.		Mean of Maximum.	Mean of Minimum.	Daily Range.										
Lowest.	Date.			Mean.	Greatest.	Date.	Least.	Date.			Total Inches.	Total Snowfall During Month.	Depth of Snow on Ground at End of Month.	Number of Days
3·0	7, 10	46·7	29·0	17·7	33·0	13	3·0	28	. . .	. . .	4·51	11·50	. . .	
7·0	21	50·4	33·4	17·0	31·0	11	7·0	9	76·5	35·0	5·52	2·25	. . .	
7·0	10	48·4	25·4	23·0	40·0	4	5·0	2	81·9	31·5	2·81	2·00	. . .	
7·0	7	45·6	28·9	16·7	37·0	18	8·0	4	94·3	33·7	4·05	2·50	. . .	
5·0	10	49·8	33·5	16·3	30·0	19	8·0	24	67·1	30·0	4·09	. . .	. . .	
7·0	24	40·3	27·2	13·1	. . .	. . .	. . .	. . .	. . .	. . .	3·66	31·00	. . .	
4·0	10	47·5	26·3	21·2	38·0	13	9·0	28	82·5	33·0	4·76	6·80	. . .	
. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	
9·8	7	42·8	23·6	19·2	33·0	5	4·5	19	77·7	27·8	2·46	2·00	. . .	
0·0	7	39·0	24·8	14·2	30·0	5	2·0	19	. . .	. . .	2·96	8·00	. . .	
. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	4·28	. . .	. . .	
4·7	7	46·3	27·9	18·4	32·0	5	7·0	28	80·0	29·9	5·18	1·50	. . .	
4·0	7, 14	43·2	26·6	16·6	34·0	18	6·0	28	. .	. . .	3·83	3·00	. . .	
2·0	10	51·0	30·0	21·0	33·0	13	8·0	9	83·4	33·4	5·05	7·05	. . .	
7·0	10	46·3	24·7	21·6	32·0	5	6·0	9	. . .	. . .	5·02	8·00	. . .	
4·0	7	45·0	27·0	18·0	35·5	18	6·0	28	. . .	. . .	5·36	3·00	. . .	
0·0	9	44·0	26·3	17·7	38·0	5	7·0	28	85·2	31·5	4·31	4·65	. . .	
4·0	10	47·8	23·1	24·7	44·0	13	12·0	14	. . .	. . .	5·14	6·50	. . .	
8·0	7	47·8	31·1	16·7	27·0	5	6·5	24	72·0	30·0	5·41	3·00	. . .	
8·0	11	49·6	29·8	19·8	35·0	18	7·0	28	. . .	. . .	4·88	. . .	. . .	
3·0	7	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	4·74	. . .	. . .	
9·0	7	47·6	29·7	17·9	26·0	5	6·5	24	. . .	. . .	2·39	3·00	. . .	
5·0	21	41·1	27·4	13·7	31·0	5	2·0	15	. . .	. . .	. . .	6·00	. . .	
8·0	10	44·4	24·8	19·6	36·0	5	8·0	9	86·1	31·0	4·78	6·95	. . .	
2·0	10, 29	42·0	26·5	15·5	34·0	13	4·0	14	. . .	. . .	5·52	9·00	. . .	
2·0	11	43·4	26·1	17·1	35·0	18	6·0	28	. . .	. . .	4·04	6·10	. . .	
8·0	7	44·5	31·5	13·0	. . .	. . .	. .	. . .	. . .	. . .	3·41	9·00	. . .	
9·0	10	46·3	29·7	16·6	39·0	18	5·0	2	84·5	33·0	4·12	6·00	. . .	
8·0	7	44·0	30·7	13·9	36·0	5	4·0	15	77·4	30·6	3·39	. . .	. . .	
1·0	7, 21	44·2	33·1	11·1	27·8	5	6·0	1	80·0	34·0	3·93	1·00	. . .	
4·0	21	43·0	27·0	16·0	32·0	4	5·0	6	84·0	29·0	3·60	. . .	. . .	
9·0	22	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	4·73	2·00	. . .	
. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	
5·0	10	48·2	27·7	20·5	36·0	18	9·0	8	86·2	28·0	3·90	6·50	. . .	
6·0	10	49·0	29·2	19·8	33·0	18	9·0	28	78·6	32·7	4·00	4·50	. . .	
. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	5·10	. . .	. . .	
7·5	10	48·5	26·9	21·6	37·5	13	9·5	2	. . .	. . .	5·18	. . .	. . .	
9·0	10	42·4	28·4	14·0	33·0	13	6·0	15	. . .	. . .	4·98	5·50	. . .	
11·0	21	47·2	31·1	16·1	36·5	5	7·5	1	79·8	32·6	5·89	3·00	. . .	
15·0	21	47·9	26·9	21·0	33·0	19	12·0	9	80·0	32·7	3·14	3·00	. . .	
12·0	21	48·8	29·1	19·7	34·0	28	7·0	7	. . .	. . .	6·39	5·37	. . .	
15·0	7	44·7	27·8	16·9	37·5	18	9·0	28	83·1	32·0	3·78	1·50	. . .	
19·0	7	. . .	. . .	. . .	36·0	18	2·0	4	84·9	35·2	. . .	. . .	. . .	
20·0	7, 21	48·9	33·5	15·4	34·0	18	3·0	4	. . .	. . .	3·34	. . .	. . .	
17·0	7, 21	48·6	29·4	19·2	37·0	5	8·0	28	. . .	. . .	5·32	1·50	. . .	
12·0	7	45·5	26·9	18·6	38·0	19	7·0	2	. . .	. . .	5·00	. . .	. . .	
11·0	7	42·7	25·5	17·2	28·0	5	7·0	1	. . .	. . .	3·60	6·00	. . .	
12·0	7, 21	47·0	27·0	20·0	35·0	19	10·0	28	. . .	. . .	3·00	2·00	. . .	
. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	3·70	6·00	. . .	
12·1	21	45·0	26·6	18·4	36·5	5	6·0	3	89·1	30·9	5·05	5·00	. . .	
15·5	10	48·1	28·2	19·9	36·0	18	10·0	4	77·8	31·3	4·16	5·30	. . .	
19·0	7	48·0	33·4	14·6	30·0	18	7·0	28	75·6	34·0	4·81	2·00	. . .	
17·0	7	47·0	30·5	16·5	36·0	18	7·0	28	78·0	33·0	4·67	2·00	. . .	
16·0	7	43·9	29·5	14·4	39·0	26	4·0	27	. . .	. . .	6·11	4·70	. . .	
21·0	7, 21	49·0	33·9	15·1	26·0	8	7·0	19	74·0	31·4	3·39	. . .	. . .	
1·0	11	41·3	25·4	15·9	34·0	11	7·0	15	89·5	29·3	5·90	8·00	. . .	
15·0	7	43·0	27·0	16·0	27·0	16	8·0	24	. . .	. . .	4·56	6·00	. . .	
. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	
10·0	10, 21	46·4	28·9	17·5	34·0	5	6·0	14	82·1	32·5	4·51	8·00	. . .	
8·0	21	35·6	22·5	13·1	27·0	5	4·0	28	77·8	24·0	6·20	13·50	. . .	
4·0	11	42·9	25·7	17·2	40·0	13	5·0	28	74·5	26·0	2·28	11·50	. . .	
16·0	7	44·9	29·0	15·9	32·0	18	8·0	28	. . .	. . .	3·89	3·40	. . .	
2·0	11	42·1	25·7	16·4	30·0	11	2·0	12	. . .	. . .	4·68	6·00	. . .	
13·0	10	51·3	28·5	22·8	40·0	21	10·0	3	77·2	32·3	5·55	2·25	. . .	
0	23	40·0	21·4	18·6	42·0	23	5·0	28	. . .	. . .	3·74	7·50	. . .	
3·0	23	41·4	25·0	16·4	42·0	23	4·0	6	72·8	29·6	3·19	8·00	. . .	
15·5	22	52·4	31·7	20·7	32·0	13	8·0	9	76·2	35·7	4·41	2·00	. . .	
9·0	7	43·6	26·1	17·5	32·0	19	7·0	28	. . .	. . .	3·09	7·00	. . .	
19·0	7	48·2	30·1	18·1	33·5	26	11·0	24	79·5	31·5	2·85	1·50	. . .	

CIPITATION.			NUMBER OF DAYS.			WIND.			OBSERVERS.
During Month.	Depth of Snow on Ground at End of Month.	Number of Days Rainfall.	Clear.	Fair.	Cloudy.	PREVAILING DIRECTION. 7 A. M.	2 P. M.	9 P. M.	
0	. . .	13	11	5	12	N	SW	SW	Prof. E. S. Breidenbaugh.
5	. . .	15	5	5	18	N	N	N	Oscar D. Stewart, Sgt. Sig. Corps.
0	. . .	12	8	8	12	W	W	SW	Miss E. A. G. Apple.
0	. . .	8	12	4	12	NW	NW	NW	C. M. Dechant, C.E.
.	. . .	18	. . .	. . .	. . .	. . .	. . .	. . .	Dr. Charles B. Dudley.
0	. . .	14	3	10	13	NW	NW	NW	A. H. Boyle.
0	. . .	11	13	4	12	W	W	W	Prof. J. A. Stewart.
.	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	Miss Cora J. Wilson.
0	. . .	10	5	6	17	SE	SW	SE	Charles Beecher.
0	. . .	9	4	7	17	SW	SW	SW	Geo. W. T. Warburton.
.	. . .	12	12	8	8	NW	NW	W	J. C. Hilsman.
0	. . .	12	3	14	11	NE	NE	NE	J. L. Heacock.
0	. . .	9	4	10	14	NE	NW	NW	Lewis P. Townsend.
5	. . .	18	6	4	18	NW	NW	NW	E. C. Lorentz.
0	. . .	12	5	7	16	W	W	W	T. B. Lloyd.
0	. . .	10	16	5	7	NW	NW	NW	John J. Boyd.
5	. . .	10	6	8	14	W	W	W	Prof. Wm. Frear.
0	. . .	13	6	3	19	SW	SW	SW	Geo. H. Dunkle.
0	. . .	15	9	5	14	NW	NW	NW	Jesse C. Green, D.D.S.
.	. . .	10	8	6	14	S	W	W	W. T. Gordon.
0	. . .	12	2	11	15	N	N	N	Benj. P. Kirk.
0	. . .	12	4	11	13	NW	NW	W	Prof. Wm. F. Wickersham.
0	. . .	9	4	6	18	W	W	W	Rev. W. W. Deatrick, A.M.
5	. . .	11	5	7	16	W	W	W	C. M. Thomas, B.S.
0	. . .	16	3	11	14	W	SW	W	Nathan Moore.
0	. . .	11	5	6	17	W	W	W	Prof. John A. Robb.
0	. . .	11	. . .	. . .	. . .	. . .	. . .	. . .	Robert M. Graham.
0	. . .	9	5	9	14	NE	W	W	J. E. Pague.
.	. . .	11	3	12	13	NW	NW	NW	Frank Ridgway, Sgt. Sig. Corps.
0	. . .	9	2	8	18	NW	NW	NW	Prof. Susan J. Cunningham.
.	. . .	17	5	5	18	S	S	S	Peter Wood, Sgt Sig. Corps.
0	. . .	10	6	15	7	. . .	. . .	. . .	Wm. Hunt.
.	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	R. L. Haslet.
0	. . .	11	12	3	13	. . .	. . .	. . .	Miss Mary A. Ricker.
0	. . .	10	9	8	11	W	W	W	Thomas F. Sloan.
.	. . .	11	. . .	. . .	. . .	. . .	. . .	. . .	Capt. W. C. Kimber.
.	. . .	15	4	13	11	W	W	W	Prof. W. J. Swigart.
0	. . .	9	9	8	11	W	W	W	J. E. Rooney.
0	. . .	12	3	9	14	NW	W	SW	Prof. S. C. Schmucker.
0	. . .	10	3	10	15	NW	NW	SE	E. E. Weller.
7	. . .	11	7	5	16	W	W	W	Wm. T. Butz.
0	. . .	9	6	6	16	E	W	W	Wm. H. Kline.
.	. . .	. . .	1	12	15	E	E	E	Geo. W. Bowman, A.M., Ph.D.
.	. . .	12	4	12	12	NW	NW	NW	H. W. Mullen.
0	. . .	10	10	5	13	NW	NW	NE	M. H. Boye.
.	. . .	. . .	8	7	13	NW	NW	NW	John C. Wuchter.
0	. . .	8	6	6	16	NW	NW	NW	H. D. Miller, M.D.
0	. . .	9	15	0	13	NE	. . .	E	A. W. Betterly.
0	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	John S. Gibson, P. M.
0	. . .	13	4	4	20	S	. . .	SW	Prof. S. H. Miller.
0	. . .	14	7	7	14	NW	NW	NW	Culbertson & Lantz.
0	. . .	8	9	8	11	NE	NE	NE	Charles Moore, D.D.S.
0	. . .	11	15	2	11	NW	N	NE	Lerch & Rice.
0	. . .	8	9	7	12	NW	W	W	Frank Mortimer.
.	. . .	13	7	5	16	NE	NE	NE	Luther M. Dey, Sgt. Sig. Corps.
0	. . .	11	. . .	. . .	. . .	NW	. . .	W	C. L. Peck.
0	. . .	11	4	15	9	W	NW	W	E. C. Wagner.
.	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	J. M. Boyer,
0	. . .	9	4	10	14	SW	SW	SW	W. M. Schrock.
0	. . .	9	2	12	14	SW	SW	SW	E. S. Chase.
0	. . .	14	3	12	13	S	SW	S	H. D. Deming.
0	. . .	8	1	15	12	NE	. . .	SW	F. O. Whitman.
0	. . .	18	3	6	19	SW	SW	SW	Wm. Loveland.
5	. . .	14	6	9	13	W	W	W	A. L. Runion, M.D.
0	. . .	10	6	7	15	W	W	W	Theodore Day.
0	. . .	10	. . .	. . .	. . .	. . .	. . .	. . .	John Torrey.
0	. . .	12	2	8	16	W	W	W	Hilary S. Brunot.
0	. . .	8	9	6	13	S	S	S	Benj. M. Hall.
0	. . .	14	8	7	13	NW	. . .	SW	Mrs. L. H. Grenewald.

T. F. TOWNSEND, *Sergeant Signal Corps, Assistant.*

10th, 11th, 12th, 13th, 15th, 16th; Quakertown, 10th, 11th, 13th, 17th, 23d, 27th; Emporium, 1st, 7th, 10th, 11th, 12th, 13th, 16th, 17th; State College, 7th, 11th, 12th, 13th, 16th, 17th; Phillipsburg, 16th; Westtown, 11th, 17th, 23d; Lock-Haven, 7th, 15th, 16th; Catawissa, 13th, 16th, 17th; Carlisle, 11th; Uniontown, 13th, 16th, 17th; Chambersburg, 10th, 11th, 13th, 17th; Petersburg, 7th, 10th, 11th, 12th, 13th, 16th, 17th; Lancaster, 7th, 10th, 11th, 13th, 23d; Annville, 7th, 10th, 11th, 13th, 17th, 18th; Coopersburg, 2d, 5th, 6th, 7th, 9th, 10th, 11th, 12th, 13th, 14th, 16th, 17th, 19th, 20th, 21st, 22d, 23d; Nisbet, 10th, 16th; Greenville, 16th; Lewistown, 6th, 7th, 9th, 10th, 11th, 12th, 13th, 16th, 17th, 23d; Girardville, 2d, 6th, 7th, 9th, 10th, 11th, 13th, 16th, 17th, 21st, 22d, 23d; Wellsboro, 1st, 2d, 3d, 6th, 7th, 8th, 9th, 10th, 11th, 12th, 13th, 16th, 17th, 19th, 20th, 21st, 22d, 23d; Columbus, 1st, 2d, 6th, 7th, 8th, 9th, 10th, 11th, 12th, 13th, 15th, 16th, 17th, 19th, 20th, 21st, 22d, 23d, 27th; Cannonsburg, 12th, 13th, 16th; Dyberry, 7th, 13th; Honesdale, 16th, 17th; South Eaton, 1st, 2d, 5th, 6th, 7th, 8th, 9th, 10th, 11th, 12th, 13th, 14th, 15th, 16th, 17th, 19th, 20th, 21st, 22d, 23d; York, 10th, 11th, 13th, 16th, 17th, 23d.

Sleet.—Gettysburg, 19th; Charlesville, 19th; Blue Knob, 7th, 18th, 19th; Hollidaysburg, 7th; Johnstown, 7th; State College, 19th; Uniontown, 7th; Lancaster, 19th; Annville, 1st, 19th; Greenville, 7th; Lewistown, 7th, 19th; Bethlehem, 7th; New Bloomfield, 19th; Girardville, 7th, 19th, 20th; Wellsboro, 7th; Cannonsburg, 7th; Dyberry, 2d; Honesdale, 7th, 8th.

Coronæ.—Charlesville, 4th, 24th; Blue Knob, 12th; Rimersburg, 4th; Annville, 6th, 11th, 17th, 22d, 24th; Lewistown, 1st, 2d, 3d, 4th, 24th, 25th, 26th; Eagles Mere, 5th; Dyberry, 7th.

Aurora—Lewistown, 15th

Solar Halos.—Le Roy, 17th, 19th, 26th, 27th; Coatesville, 17th; Carlisle, 7th, 24th, 26th; Annville, 5th, 6th, 7th; Philadelphia, 17th; Eagles Mere, 1st, 16th, 17th, 19th, 26th, 27th; Dyberry, 19th.

Lunar Halos.—Blue Knob, 24th; Le Roy, 4th; State College, 24th; Uniontown, 4th; Petersburg, 7th; Lancaster, 5th; Centre Valley, 3d, 9th; Lewistown, 5th, 24th; Philadelphia, 4th; Girardville, 5th; Somerset, 3d, 4th, 5th, 25th; Eagles Mere, 9th; York, 5th; Hulmeville, 3d.

Meteors.—State College, 26th; Eagles Mere, 4th.

Parhelias.—Eagles Mere, 10th, 17th; Dyberry, 16th.

Zodiacal.—Coatesville, 15th, 18th, 20th.

WEATHER FORECASTS.

Percentage of local verifications of weather and temperature signals as reported by displaymen for January, 1890:

Weather, 79 per cent.

Temperature, 78 per cent.

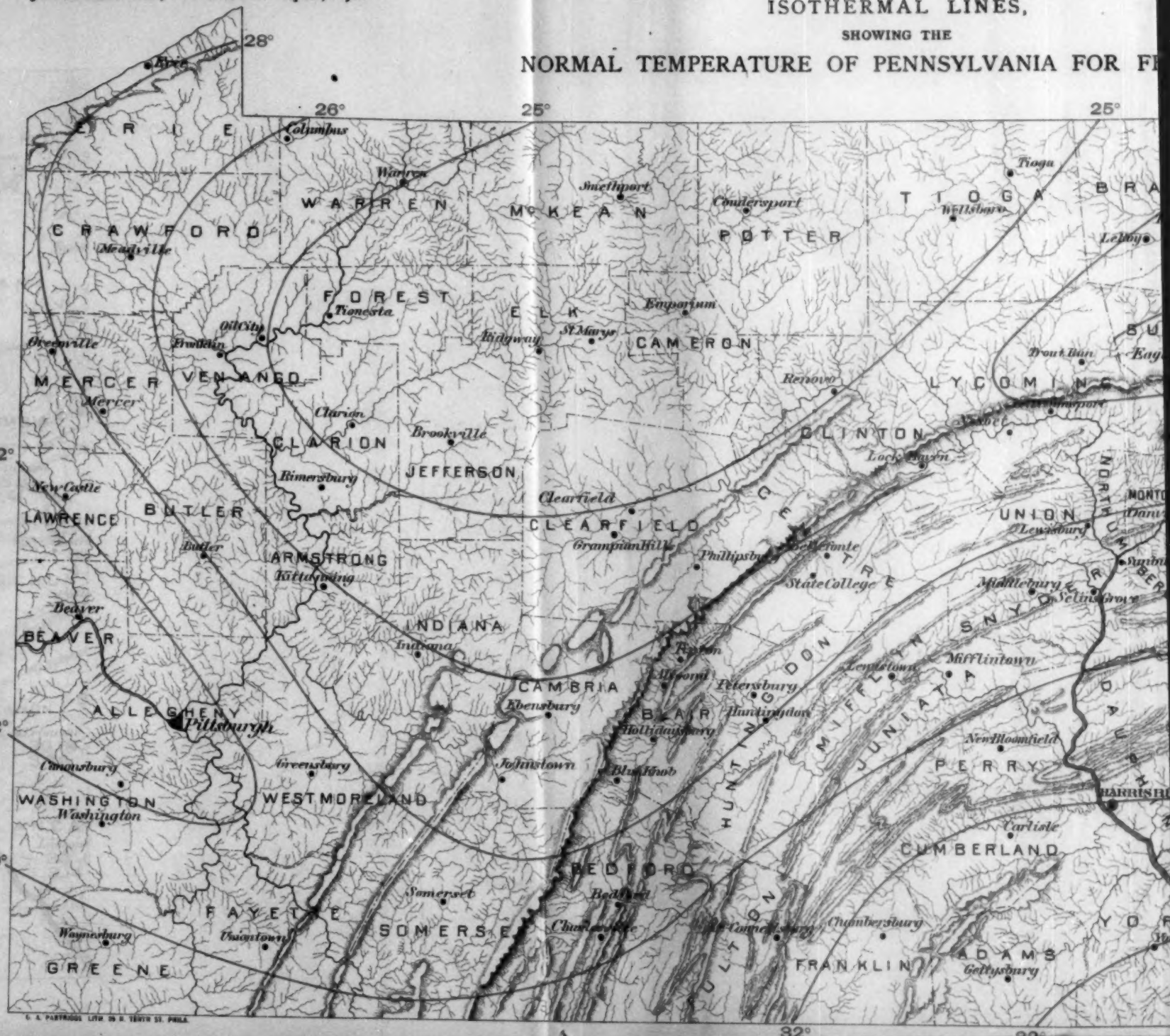
TEMPERATURE AND WEATHER SIGNAL DISPLAY STATIONS.

Displayman.	*Station.*
U. S. Signal Office,	Philadelphia.
Wanamaker & Brown,	"
Pennsylvania Railroad Company,	"
Continental Brewing Company,	"
Samuel Simpson,	"
B. T. Babbitt,	"
Western Meat Company,	"
Neptune Laundry,	"
C. W. Burkhart,	Shoemakersville.
A. N. Lindenmuth,	Allentown.
C. B. Whitehead,	Bradford.
Capt. Geo. R. Guss,	West Chester.
Thomas F. Sloan,	McConnellsburg.
J. H. Fulmer,	Muncy.
W. T. Butz,	New Castle.
Capt. A. Goldsmith,	Quakertown.
Postmaster,	Meadville.
Frank Ross,	Oil City.
Lerch & Rice,	Bethlehem.
John W. Aitken,	Carbondale.
Signal Office,	Erie.
J. R. Raynsford,	Montrose.
E. P. Wilbur & Co.,	South Bethlehem.
Agricultural Experiment Station,	State College.
Signal Office,	Pittsburgh.
New Era,	Lancaster.
State Normal School,	Clarion.
Clarion Collegiate Institute,	Rimersburg.
Thiel College,	Greenville.
D. G. Hurley,	Altoona.
J. E. Forsythe,	Butler.
James H. Fones,	Tionesta.
Steward M. Dreher,	Stroudsburg.
State Normal School,	Millersville.
E. C. Wagner,	Girardville.
Hartford P. Brown,	Rochester.
L. H. Grenewald,	York.
J. E. Pague,	Carlisle.
C. L. Peck,	Coudersport.
H. D. Miller,	Drifton.
M. Tannehill,	Confluence.
S. C. Burkholder,	Pollock.
Robt. M. Graham,	Catawissa.
Henry F. Bitner,	Millersville.

ISOTHERMAL LINES,

SHOWING THE

NORMAL TEMPERATURE OF PENNSYLVANIA FOR FE

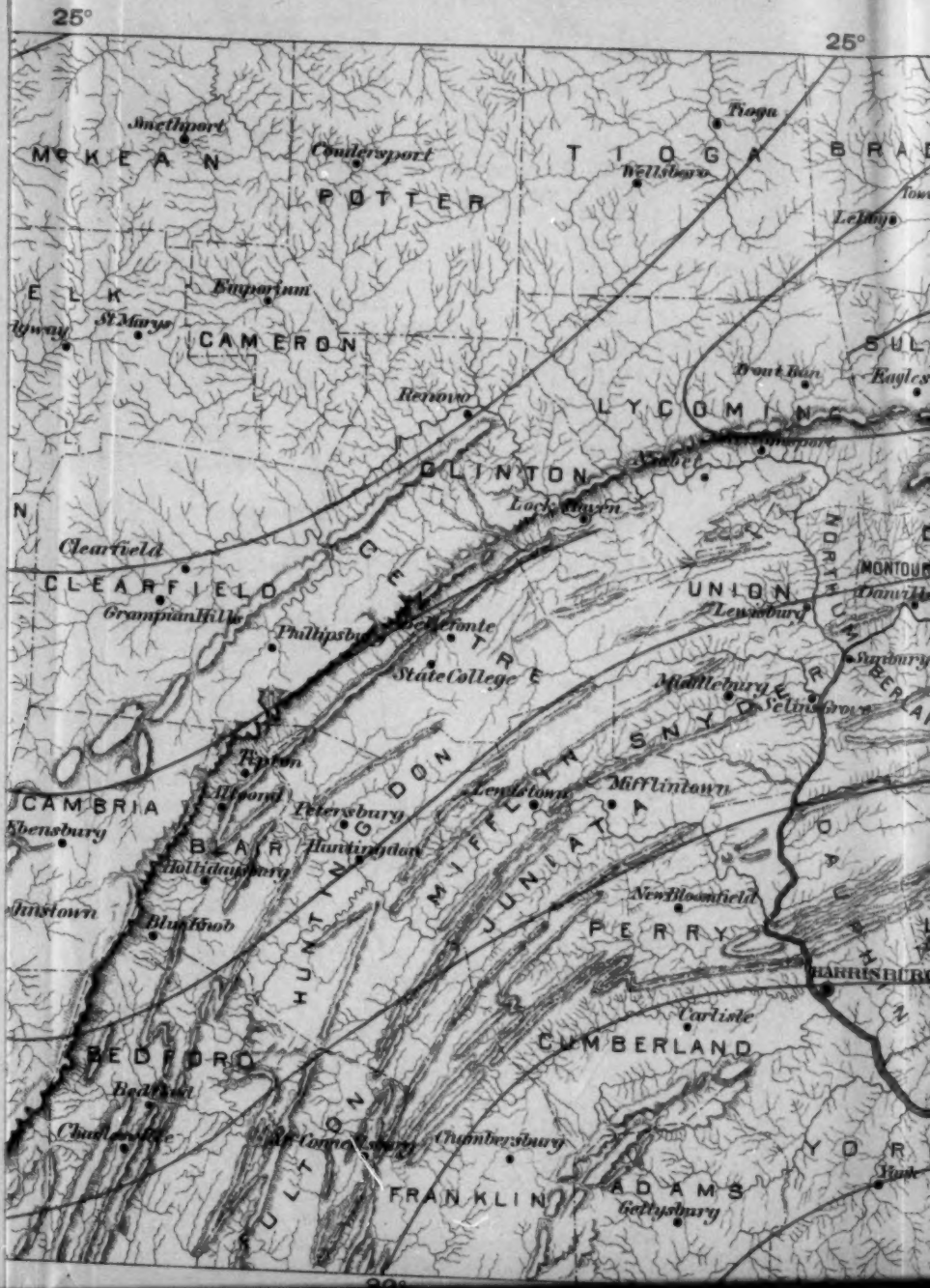


C. A. PARTRIDGE, LITH. 29 S. TENTH ST. PHILA.

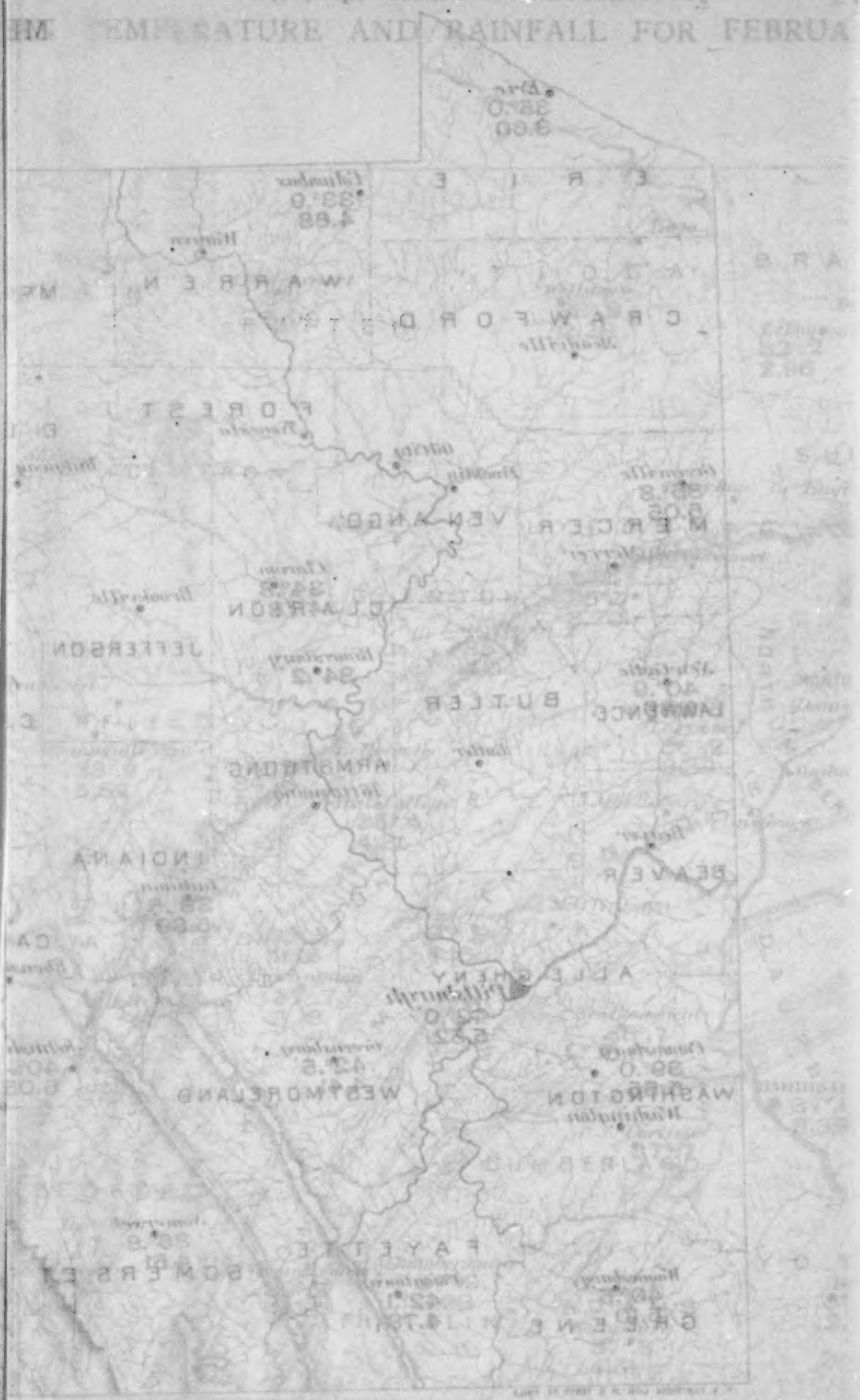
ISOTHERMAL LINES,

SHOWING THE

NORMAL TEMPERATURE OF PENNSYLVANIA FOR FEE



FOR FEBRUARY.


TEMPERATURE AND RAINFALL FOR FEBRUA

Displayman.	*Station.*
A. M. Wildman,	Lahongne.
G. W. Klee,	Chambersburg.
A. Simon's Sons,	Lock Haven.
J. K. M. McGowan,	Lock No. 4.
Raftsman's Journal,	Clearfield.
W. S. Ravenscroft,	Hyndman.
R. C. Schmidt & Co.,	Belle Vernon.
H. W. Mullen,	Centre Valley.
Chas. B. Lutz,	Bloomsburg.
E. C. Lorentz,	Johnstown.
W. M. James,	Ashland.
Miller & Allison,	Punxsutawney.
Dr. A. L. Runion,	Canonsburg.
E. J. Sellers,	Kutztown.
T. F. Heebner,	Scranton.
H. J. Fosnot,	Lewistown.
H. M. Kaisinger,	Hartsville.
E. Jennet,	Franklin.
Milton C. Cooper,	Ashbourne.
Geo. W. Bowman,	Annville.
P. S. Weber,	DuBois.
Foulk & Co.,	Milford.
William Lawton,	Wilmington, Del.

PENNSYLVANIA STATE WEATHER SERVICE.

MONTHLY WEATHER REVIEW

FOR MARCH, 1890.

Prepared under the Direction of the Committee on Meteorology of the FRANKLIN INSTITUTE.

HALL OF THE FRANKLIN INSTITUTE,
PHILADELPHIA, March 31, 1890.

TEMPERATURE.

The mean temperature of 61 stations for March, 1890, was 33°.4, which is 5°.5 below that of the corresponding month of 1889, and 2°.5 below the normal.

The mean of the daily maximum and minimum temperatures 41°.7 and 24°.6 give an average daily range of 17°.1, and a monthly mean of 33°.1.

Highest monthly means, 38°.8 at Philadelphia.

Lowest monthly means, 26°.3 at Eagles Mere.

Highest temperatures recorded during the month, 76° on the 12th, at Coatesville, Lancaster, Centre Valley, Annville and Pottstown.

Lowest, minus 16°, at Blue Knob and Columbus, on the 7th.

Greatest local monthly range, 23°.5 at Charlesville.

Least local monthly range, 11°.9 at Rimersburg and Eagles Mere.

Greatest daily range, 59° at Charlesville on the 12th.

Least daily range, 1° at Petersburg on the 13th.

The warmest day of the month was on the 12th. On this day 23 stations recorded a temperature of over 70°.

The coldest day was on the 7th, when 29 stations recorded a temperature below zero.

BAROMETER.

The mean pressure for the month was 30.07, which is about .05 above the normal.

The highest observed was 30.67 at Johnstown on the 9th, and the lowest 29.17, at Greenville, on the 28th.

PRECIPITATION.

The average rainfall [including melted snow] was 5.15 inches which is an excess of two inches.

The largest totals reported were Quakertown, 8·31; Pottstown, 8·05; and Coopersburg, 7·92 inches. Considerable snow fell during the month. The average of 53 stations was 17·5 inches.

Stations reporting the largest total snowfall, in inches, were Blue Knob, 46; Eagles Mere, 49; Grampian Hills, 33; Wellsboro, 29; Le Roy, Quakertown, Phillipsburg and Dyberry, each 26 inches. Very little remained on the ground at the end of the month.

WIND AND WEATHER.

The prevailing wind was from the northwest. The weather was favorable for the growth of winter grain and grass.

Average number.—Rainy days, 16; clear days, 6; fair days, 10; cloudy days, 15.

MISCELLANEOUS PHENOMENA.

Thunder-storms.—Pittsburgh, 28th; Blue Knob, 25th; Le Roy, 26th; Quakertown, 28th; Emporium, 21st, 26th; Phillipsburg, 27th; Coatesville, 28th; Kennett Square, 28th; Westtown, 21st; Rimersburg, 21st; Swarthmore, 28th; Uniontown, 21st, 28th; Lancaster 28th; Myerstown, 19th, 28th; Annville, 28th; Centre Valley, 28th; Greenville, 21st; Pottstown, 22d; Wellsboro, 21st; Columbus, 21st, 27th; Cannonsburg, 28th; Meadville, 21st, 25th, 28th.

Hail.—Blue Knob, 28th; Emporium, 28th; West Chester, 6th; Coatesville, 28th; Swarthmore, 6th; Centre Valley, 28th; Dyberry, 25th; Meadville, 14th.

Snow.—Charlesville, 1st, 4th, 5th, 6th, 15th, 19th, 28th, 29th, 31st; Reading, 6th, 15th, 16th, 17th, 19th 30th; Blue Knob, 1st, 2d, 4th, 5th, 6th, 10th, 14th, 15th, 16th, 17th, 18th, 19th, 23d, 26th, 27th, 28th, 29th, 30th, 31st; Hollidaysburg, 1st, 4th, 5th, 6th, 14th, 15th, 16th, 19th, 28th, 29th, 30th, 31st; Tipton, 4th, 5th, 6th, 14th, 19th; Wysox, 4th, 5th, 10th, 11th, 12th, 15th, 18th, 20th, 22d, 25th, 31st; Le Roy, 4th, 5th, 6th, 14th, 15th, 16th, 17th, 19th, 23d, 26th, 28th, 29th, 30th; Quakertown, 5th, 6th, 15th, 16th, 17th, 19th, 23d, 29th, 30th, 31st; Johnstown, 1st, 2d, 4th, 5th, 6th, 15th, 16th, 17th, 19th, 23d, 28th, 29th, 30th, 31st; Emporium, 6th, 15th, 16th, 19th, 26th, 28th, 29th, 30th, 31st; Mauch Chunk, 5th, 6th, 15th, 16th, 17th, 19th, 30th, 31st; State College, 4th, 5th, 15th, 16th, 17th, 29th, 30th; Phillipsburg, 1st, 4th, 5th, 14th, 15th, 16th, 17th, 19th, 21st, 29th, 30th, 31st; West Chester, 1st, 5th, 6th, 15th, 19th, 30th, 31st; Coatesville, 5th, 6th, 15th, 16th, 19th, 29th, 30th, 31st; Kennett Square, 5th, 6th, 15th, 19th, 31st; Westtown, 1st, 5th, 16th, 19th, 29th, 30th, 31st; Rimersburg, 1st, 4th, 5th, 15th, 16th, 17th, 19th, 26th, 29th, 30th, 31st; Clarion, 4th, 5th, 15th, 16th, 17th, 18th, 19th; Lock Haven, 4th, 5th, 6th, 19th, 29th, 30th, 31st; Carlisle, 4th, 5th, 14th, 19th, 30th, 31st; Swarthmore, 6th, 16th, 17th, 19th, 30th, 31st; Uniontown, 1st, 2d, 4th, 5th, 6th, 10th, 14th, 15th, 16th, 19th, 28th, 29th, 30th, 31st; Waynesburg, 4th, 7th, 16th, 17th, 18th, 20th, 29th, 31st; Huntingdon, 4th, 6th, 19th, 29th, 31st; Petersburg, 2d, 4th, 5th, 6th, 14th, 15th, 16th, 17th, 19th, 23d, 29th, 30th, 31st; Indiana, 4th, 5th, 6th, 19th, 23d, 31st; Lancaster, 5th, 6th, 15th, 16th, 19th, 29th, 31st; New Castle

County.	Station.	Elevation above Sea. Level (feet).	Barometer Reduced to Sea Level.			Temperature.													Relative Humidity.	Dew Point.
							Maximum.		Minimum.				Daily Range.							
			Mean.	Highest.	Lowest.	Mean.	Highest.	Date.	Lowest.	Date.	Mean of Maximum.	Mean of Minimum.	Mean.	Greatest.	Date.	Least.	Date.		
Adams,[1]	Gettysburg,	624	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	42·7	28·9	13·8	29·0	9	6·0	29	83·6	30·2
Allegheny,[1]	Pittsburgh,	847	30·090	30·610	29·290	35·8	68·0	12	5·0	7	44·8	21·3	23·5	59·0	12	7·5	29	73·1	26·7
Bedford,	Charlesville (26 days),	1,300	. . .	. . .	. . .	34·0	74·0	12	—18·0	7	44·8	21·3	23·5	59·0	12	7·5	29	73·1	26·7
Berks,[1]	Reading,	304	30·125	30·657	29·679	35·5	75·0	12	9·0	9	44·8	26·2	18·6	39·0	12	8·0	21	. . .	. . .
Blair,[2]	Altoona,	1,181	. . .	. . .	. . .	37·9	68·0	13	2·0	7	47·4	28·4	19·0	38·0	7	11·0	11	59·1	24·5
Blair,	Blue Knob,	2,500	. . .	. . .	. . .	27·9	68·0	13	— 7·0	7	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Blair,	Hollidaysburg,	947	. . .	. . .	. . .	33·4	63·0	12	—16·0	7	42·5	22·4	20·1	44·0	7	10·0	11	84·0	29·0
Blair,	Tipton,	915	. . .	. . .	. . .	34·3	68·0	12	—14·0	7	40·3	26·1	14·2	47·0	7	4·0	31	. . .	. . .
Bradford,	Wysox,	718	30·088	30·613	29·447	30·3	64·5	12	— 4·5	8	38·4	21·3	17·1	39·5	10	5·5	14	74·9	20·6
Bradford,	Le Roy,	1,400	. . .	. . .	. . .	27·9	61·0	12	0·0	6	35·7	22·0	13·7	27·0	27	4·0	14	. . .	. . .
Bucks,	Forks of Neshaminy,	. . .	. . .	. . .	. . .	36·5	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Bucks,	Quakertown,	536	30·060	30·570	29·620	33·8	73·2	12	3·5	7	43·1	24·8	18·3	39·2	12	9·0	28	79·3	27·1
Bucks,	Hulmeville,	120	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Cambria,[1]	Johnstown,	1,184	30·134	30·670	29·370	34·3	68·0	12	— 4·5	7	43·3	25·4	17·9	39·0	9	7·0	30	82·5	27·5
Cameron,	Emporium,	1,030	. . .	. . .	. . .	33·3	57·0	21	—13·0	7	41·2	23·4	18·8	41·0	7	6·0	1	. . .	. . .
Carbon,[1]	Mauch Chunk,	530	. . .	. . .	. . .	34·0	72·0	12	6·5	7	42·6	25·4	17·2	36·0	12	6·0	11	. . .	. . .
Centre,	State College—Agricultural Experiment Station,	1,191	30·028	30·597	29·418	31·0	64·0	12	— 6·0	7	38·7	22·5	16·2	30·0	7	8·0	11	87·6	27·3
Centre,	Phillipsburg,	1,350	. . .	. . .	. . .	29·4	66·0	12	—21·0	7	41·1	19·0	22·1	53·0	9	5·0	13	. . .	. . .
Chester,	West Chester,	455	30·040	30·589	29·286	36·1	73·0	12	5·0	7	45·0	28·2	16·8	25·0	12	7·0	31	69·0	26·5
Chester,	Coatesville,	380	. . .	. . .	. . .	36·4	76·0	12	6·0	7	47·1	27·8	19·3	34·0	12	6·0	22	. . .	. . .
Chester,[1]	Kennett Square,	275	. . .	. . .	. . .	34·8	64·0	12	7·0	6	. . .	. . .	. . .	20·0	12	1·0	16	. . .	. . .
Chester,	Westtown,	350	30·059	30·554	29·309	37·8	72·5	12	8·0	7	45·3	29·4	15·9	28·0	28	6·0	14	. . .	. . .
Clarion,	Rimersburg,	1,500	. . .	. . .	. . .	28·7	50·0	12	— 8·0	7	34·6	22·7	11·9	36·0	9	2·0	13	. . .	. . .
Clarion,	Clarion—State Normal School (23 days),	1,530	. . .	. . .	. . .	28·2	50·0	12	—10·0	7	37·1	19·9	17·2	40·5	9	8·0	2	. . .	. . .
Clearfield,	Grampian Hills,	1,450	. . .	. . .	. . .	28·3	60·0	12	—14·0	7	36·0	21·6	14·4	40·0	7	4·0	13	. . .	. . .
Clinton,	Lock Haven,	560	. . .	. . .	. . .	32·9	51·0	12	—12·0	7	39·0	23·3	15·7	43·0	7	3·0	26	. . .	. . .
Columbia,	Catawissa,	491	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Crawford,	Meadville,	1,300	. . .	. . .	. . .	28·2	58·0	12	— 3·0	7	36·2	21·3	14·9	32·5	9	6·0	10	76·0	22·8
Cumberland,	Carlisle,	480	. . .	. . .	. . .	36·0	74·0	12	6·0	7	41·6	28·0	13·6	36·0	12	6·0	22	81·0	26·0
Dauphin,[1]	Harrisburg,	361	30·083	30·538	29·457	35·6	72·0	12	8·0	7	42·3	29·0	13·3	31·0	12	3·0	1	74·8	27·8
Delaware,	Swarthmore—Swarthmore College,	190	30·039	30·518	29·666	37·6	72·0	12	8·0	7	47·0	30·6	16·4	29·4	20	3·9	14	81·0	32·0
Erie,[1]	Erie,	681	30·040	30·570	29·180	31·0	62·0	12	2·0	7	38·0	24·0	14·0	25·0	16	4·0	2	79·5	24·3
Fayette,	Uniontown,	1,000	. . .	. . .	. . .	37·3	74·0	12	—10·0	7	43·1	29·2	13·9	38·0	7	3·0	5	. . .	. . .
Forrest,	Tionesta,	1,057	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Franklin,[1]	Chambersburg—Wilson Female College,	618	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Fulton,	McConnellsburg,	875	. . .	. . .	. . .	37·0	71·0	12, 13	— 3·0	7	45·7	27·0	18·7	37·0	7	4·0	22	77·7	28·3
Greene,	Waynesburg,	750	. . .	. . .	. . .	34·4	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Huntingdon,[1]	Huntingdon—The Normal College,	650	. . .	. . .	. . .	34·9	62·5	12	— 5·0	7	42·5	27·4	15·1	35·0	7	4·0	21	. . .	. . .
Huntingdon,	Petersburg,	700	. . .	. . .	. . .	30·7	61·0	12	— 6·0	7	38·3	25·3	13·0	34·0	9	1·0	13	. . .	. . .
Indiana,	Indiana—State Normal School,	1,350	30·048	30·497	29·545	33·4	66·0	12	— 8·0	7	39·9	21·3	18·6	36·0	20	8·0	30	79·2	27·4
Lancaster,	Lancaster,	413	30·062	30·548	29·506	36·3	76·0	12	— 4·0	7	46·0	24·2	21·8	41·0	12	10·0	31	79·2	29·9
Lawrence,	New Castle,	932	. . .	. . .	. . .	34·1	65·0	25	3·0	8	40·6	23·1	17·5	32·0	20	7·0	19	. . .	. . .
Lebanon,	Myerstown,	474	30·003	30·446	29·489	35·3	73·0	12	2·0	7	44·8	25·5	19·3	37·0	12	8·7	11	81·5	29·8
Lebanon,	Annville—Lebanon Valley College,	339	. . .	. . .	. . .	37·7	77·0	12	6·0	7	. . .	. . .	. . .	33·0	12	2·0	22	85·1	33·6
Lehigh,	Centre Valley,	348	. . .	. . .	. . .	38·4	76·0	12	11·0	7	49·1	31·0	18·1	37·0	12	2·0	22	. . .	. . .
Lehigh,	Coopersburg,	520	. . .	. . .	. . .	34·9	73·0	12	5·0	7	46·9	26·7	20·2	38·0	12	10·0	22	. . .	. . .
Lehigh,[1]	Lynnport,	350	. . .	. . .	. . .	34·8	71·0	12	4·0	7	43·3	26·3	17·0	36·0	12	6·0	11	. . .	. . .
Luzerne,	Drifton—Drifton Hospital,	1,655	. . .	. . .	. . .	28·9	64·0	12	1·0	7	39·2	19·7	19·5	34·0	21	8·0	2	. . .	. . .
Luzerne,[1]	Wilkes-Barre,	575	. . .	. . .	. . .	34·6	71·0	12	7·0	7, 8	43·7	25·6	18·1	36·0	12	8·0	25	. . .	. . .
Lycoming,[1]	Nisbet,	550	. . .	. . .	. . .	32·0	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Mercer,[1]	Greenville—Thiel College,	1,000	30·038	30·598	29·170	30·1	61·0	25	— 7·8	7	39·8	20·7	19·1	38·5	9	9·2	30	89·5	25·4
Mifflin,	Lewistown,	500	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Montgomery,	Pottstown,	150	. . .	. . .	. . .	38·0	76·0	12	5·0	7	46·0	29·0	17·0	35·0	12	5·0	23	75·0	29·0
Northampton,	Bethlehem,	300	30·013	30·465	29·431	36·0	71·0	12	2·0	7	44·0	27·0	17·0	36·0	12	6·0	11	76·0	30·0
Perry,	New Bloomfield,	400	. . .	. . .	. . .	34·3	68·0	12	— 1·0	7	40·3	27·3	13·0	34·0	12	3·0	29	. . .	. . .
Philadelphia,[1]	Philadelphia—Signal Office,	117	30·070	30·580	29·310	38·8	73·0	12	9·0	7	46·2	31·5	14·7	21·0	9	3·0	14	68·0	28·0
Potter,	Coudersport,	1,670	. . .	. . .	. . .	27·3	55·0	13	—19·0	7	36·3	18·3	18·0	42·0	7	9·0	3	. . .	. . .
Schuylkill,	Girardville,	1,000	30·061	30·554	29·526	33·4	67·0	12	5·0	7	42·3	24·4	17·9	30·0	21	10·0	22	. . .	. . .
Snyder,	Selins Grove,	445	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Somerset,	Somerset,	2,250	. . .	. . .	. . .	38·0	65·0	12	—17·0	7	39·6	18·9	20·7	33·0	6	2·0	30	81·9	27·5
Sullivan,	Eagles Mere,	2,060	30·135	30·660	29·486	26·3	54·0	14	— 3·0	7	31·8	19·9	11·9	26·0	1	2·0	26	73·5	19·2
Tioga,	Wellsboro,	1,327	30·033	30·645	29·337	28·4	64·0	13	— 9·0	8	36·7	21·2	15·5	23·0	5	4·0	8	76·2	21·0
Union,[1]	Lewisburg,	450	. . .	. . .	. . .	34·5	61·0	12	2·0	7	43·1	26·0	17·1	30·0	9	8·0	30	. . .	. . .
Warren,	Columbus,	1,410	. . .	. . .	. . .	28·8	58·0	12, 25	—16·0	7	37·3	20·2	17·1	54·0	9	2·0	26	72·0	20·5
Washington,	Canonsburg,	950	30·083	30·425	29·522	33·0	67·0	12	— 9·0	7	42·8	24·0	18·8	36·0	9	6·0	31	77·2	26·0
Wayne,	Dyberry,	1,100	. . .	. . .	. . .	27·4	66·0	12	— 4·0	7	36·8	19·3	17·5	43·0	10	6·0	14	. . .	. . .
Wayne,	Honesdale,	1,000	. . .	. . .	. . .	30·4	64·0	12	— 1·0	7	39·0	21·9	17·1	42·0	10	4·0	14	69·0	27·0
Westmoreland,	Greensburg,	1,175	. . .	. . .	. . .	35·1	69·0	12	— 4·5	7	44·1	26·3	17·8	38 7	9	9·3	31	. . .	. . .
Wyoming,[1]	South Eaton	660	. . .	. . .	. . .	31·3	65·0	12	5·0	8, 10	39·6	23·0	16·6	34·0	10	4·0	19	. . .	. . .
York,[1]	York,	385	30·012	30·539	29·429	35·8	75·0	12	4·0	7	47·5	26·6	20·9	37·0	12	9·0	31	81·2	30·3

[1] Observations taken at 8 A. M. and 8 P. M. [2] Observations taken at 12 Noon

TEMPERATURE.												PRECIPITATI		
MUM.	MINIMUM.				DAILY RANGE.									
Date.	Lowest.	Date.	Mean of Maximum.	Mean of Minimum.	Mean.	Greatest.	Date.	Least.	Date.	Relative Humidity.	Dew Point.	Total Inches.	Total Snowfall During Month.	Depth of Snow on Ground at
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
12	5°0	7	42°7	28°9	13°8	29°0	9	6°0	29	83°6	30°2	3·86	...	...
12	—18°0	7	44°8	21°3	23°5	59°0	12	7°5	29	73°1	26°7	5·46	16·02	1·0
12	9°0	9	44°8	26°2	18°6	39°0	12	8°0	21	...	...	4·88	...	...
13	2°0	7	47°4	28°4	19°0	38°0	7	11°0	11	59°1	24°5	2·90	...	...
12	— 7°0	7	...	...	...	...	...	...	...	...	...	5·07	46·00	5·0
12	—16°0	7	42°5	22°4	20°1	44°0	7	10°0	11	84°0	29°0	4·18	14·00	...
12	—14°0	7	40°3	26°1	14°2	47°0	7	4°0	31	...	...	3·90	10·64	...
12	— 4°5	8	38°4	21°3	17°1	39°5	10	5°5	14	74·9	20·6	3·38	9·25	...
12	0°0	6	35°7	22°0	13°7	27°0	27	4°0	14	...	...	4·58	26·00	...
...	...	...	...	...	...	...	...	...	...	...	...	5·66	...	...
12	3°5	7	43°1	24°8	18°3	33°2	12	9°0	28	79·3	27°1	8·31	26·00	1·0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
12	— 4°5	7	43°3	25°4	17°9	39°0	9	7°0	30	82·5	27°5	5·74	17·90	1·0
21	—13°0	7	41°2	22°4	18°8	41°0	7	6°0	1	...	...	4·79	14·25	...
12	.6°5	7	42°6	25°4	17°2	36°0	12	6°0	11	...	...	6·07	19·00	...
12	— 6°0	7	38°7	22°5	16°2	30°0	7	8°0	11	87·6	27°3	3·85	16·60	...
12	—21°0	7	41°1	19°0	22°1	53°0	9	5°0	13	...	...	6·53	26·50	...
12	5°0	7	45°0	28°2	16°8	25°0	12	7°0	31	69·0	26°5	6·77	10·75	1·7
12	6°0	7	47°1	27°8	19°3	34°0	12	6°0	22	...	...	7·29	11·80	1·5
12	7°0	6	...	...	...	20°0	12	1°0	16	...	...	4·76	8·75	3·0
12	8°0	7	45°3	29°4	15°9	28°0	28	6°0	14	...	...	4·60	9·50	3·5
12	— 8°0	7	34°6	22°7	11°9	36°0	9	2°0	13	...	...	...	17·25	1·0
12	—10°0	7	37°1	19°9	17°2	40°5	9	8°0	2	...	...	3·08	11·70	...
12	—14°0	7	36°0	21°6	14°4	40°0	7	4°0	13	...	...	6·32	33·00	4·0
12	—12°0	7	39°0	23°3	15°7	43°0	7	3°0	20	...	...	5·48	22·00	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
12	— 3°0	7	36°2	21°3	14°9	32°5	9	6°0	10	76°0	22°8	4·81	18·05	2·0
12	6°0	7	41°6	28°0	13°6	36°0	12	6°0	22	81°0	26°0	5·87	12·00	...
12	8°0	7	42°3	29°0	13°3	31°0	12	3°0	1	74·8	27·8	3·80	6·50	...
12	8°0	7	47°0	30°6	16°4	29°4	20	3°9	14	81°0	32°0	5·20	9·00	3·0
12	2°0	7	38°0	24°0	14°0	25°0	16	4°0	2	79°5	24°3	3·43	...	...
12	—10°0	7	43°1	29°2	13°9	38°0	7	3°0	5	...	...	6·27	12·55	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
12, 13	— 3°0	7	45°7	27°0	18°7	37°0	7	4°0	22	77°7	28°3	5·41	11·00	1·0
...	...	...	...	...	...	...	...	...	...	...	...	4·65	12·00	...
19	— 5°0	7	42°5	27°4	15°1	35°0	7	4°0	21	...	...	3·61	9·60	·6
19	— 6°0	7	38°3	25°3	13°0	34°0	9	1°0	13	...	...	3·73	13·10	1·0
12	— 8°0	7	39°9	21°3	18°6	36°0	20	8°0	30	79°2	27°4	4·67	19·75	·5
12	— 4°0	7	46°0	24°2	21°8	41°0	12	10°0	31	79°2	29°9	4·84	10·00	1·0
25	3°0	8	40°6	23°1	17°5	32°0	20	7°0	19	...	...	4·29	10·59	...
12	2°0	7	44°8	25°5	19°3	37°0	12	8°7	11	81°5	29°8	6·46	15·10	...
12	6°0	7	...	...	...	33°0	12	2°0	22	85°1	33°6	...	14·60	·5
12	11°0	7	49°1	31°0	18°1	37°0	12	2°0	22	...	...	5·04	16·50	3·0
12	5°0	7	46°9	26°7	20°2	38°0	12	10°0	22	...	...	7·92	19·80	1·3
12	4°0	7	43°3	26°3	17°0	36°0	12	6°0	11	...	...	5·32	...	...
12	1°0	7	39°2	19°7	19°5	34°0	21	8°0	2	...	...	4·81	19·50	...
12	7°0	7, 8	43°7	25°6	18°1	36°0	12	8°0	25	...	...	4·89	24·00	...
...	...	...	...	...	...	...	...	...	...	...	...	4·30	...	...
25	— 7°8	7	39°8	20°7	19°1	38°5	9	9°2	30	89°5	25°4	5·12	19·80	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
12	5°0	7	46°0	29°0	17°0	35°0	12	5°0	23	75°0	29°0	8·05	16·50	3·0
12	2°0	7	44°0	27°0	17°0	30°0	12	6°0	11	76°0	30°0	6·12	22·00	...
12	— 1°0	7	40°3	27°3	13°0	34°0	12	3°0	29	...	...	5·87	12·75	...
12	9°0	7	46°2	31°5	14°7	21°0	9	3°0	14	68°0	28°0	4·61	...	...
13	—19°0	7	36°3	18°3	18°0	42°0	7	9°0	3	...	...	4·20	18·00	...
12	5°0	7	42°3	24°4	17°9	30°0	21	10°0	22	...	...	5·25	20·25	1·1
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
12	—17°0	7	39°6	18°9	20°7	33°0	6	2°0	30	81°9	27°5	5·42	30·50	3·0
12	— 3°0	7	31°8	19°9	11°9	26°0	1	2°0	26	73°5	19°2	7·61	48·60	1·0
12	— 9°0	8	36°7	21°2	15°5	23°0	5	4°0	8	76°2	21°0	6·03	29·25	·5
12	2°0	7	43°1	26°0	17°1	30°0	9	8°0	30	...	...	3·21	12·50	·5
12, 25	—16°0	7	37°3	20°2	17°1	54°0	9	2°0	26	72°0	20°5	5·13	12·00	3·0
12	— 9°0	7	42°8	24°0	18°8	36°0	9	6°0	31	77°2	26°0	4·48	11·40	...
12	— 4°0	7	36°8	19°3	17°5	43°0	10	6°0	14	...	...	5·00	26·50	1·0
12	— 1°0	7	39°0	21°9	17°1	42°0	10	4°0	14	69°0	27°0	4·48	20·00	...
12	— 4°5	7	44°1	26°3	17°8	38 7	9	9°3	31	...	...	5·54	11·40	·5
12	5°0	8, 10	39°6	23°0	16°6	34°0	20	4°0	19	...	...	4·46	16·00	...
12	4°0	7	47°5	26°6	20°9	37°0	12	9°0	31	81°2	30°3	5·44	8·00	...

Precipitation.			Number of Days.			Wind.			Observers.
						Prevailing Direction.			
Total Snowfall During Month.	Depth of Snow on Ground at End of Month.	Number of Days Rainfall.	Clear.	Fair.	Cloudy.	7 A. M.	2 P. M.	9 P. M.	
...	...	...	...	...	...	...	...	...	Prof. E. S. Breidenbaugh.
...	...	22	2	10	19	N	N	N	Oscar D. Stewart, Sgt. Sig. Corps.
16·02	1·00	14	6	8	12	N	W	N	Miss E. A. G. Apple.
...	...	11	8	10	13	NW	NW	NW	C. M. Dechant, C.E.
...	...	10	...	...	...	...	...	...	Dr. Charles B. Dudley.
46·00	5·00	20	2	10	19	NW	NW	NW	A. H. Boyle.
14·00	...	17	10	8	13	W	W	W	Prof. J. A. Stewart.
10·64	...	14	9	13	9	N	N	N	Miss Cora J. Wilson.
9·25	...	17	6	6	19	W	SW	SW	Charles Beecher.
26·00	...	17	3	10	18	SW	SW	SW	Geo. W. T. Warburton.
...	...	14	12	5	14	NW	NW	W	J. C. Hilsman.
26·00	1·00	16	6	11	14	NW	NW	NW	J. L. Heacock.
...	...	...	...	...	...	...	...	...	Lewis P. Townsend.
17·90	1·00	23	4	8	19	NW	NW	NW	E. C. Lorentz.
14·25	...	13	4	9	18	NW	W	W	T. B. Lloyd.
19·00	...	15	7	16	8	NW	NW	NW	John J. Boyd.
16·60	...	17	5	8	18	W	W	W	Prof. Wm. Frear.
26·50	...	15	4	2	25	SW	SW	SW	Geo. H. Dunkle.
10·75	1·75	18	11	8	12	NW	NW	NW	Jesse C. Green, D.D.S.
11·80	1·50	18	9	10	12	W	W	W	W. T. Gordon.
8·75	3·00	15	2	13	16	N	N	N	Benj. P. Kirk.
9·50	3·50	11	7	12	12	W	NW	NW	Prof. Wm. F. Wickersham.
17·25	1·00	21	2	10	19	SW	W	W	Rev. W. W. Deatrick, A.M.
11·70	...	19	3	8	19	W	W	W	C. M. Thomas, B.S.
33·00	4·00	21	3	7	21	W	W	W	Nathan Moore.
22·00	...	16	7	11	13	W	W	W	Prof. John A. Robb.
...	...	...	...	...	...	...	...	...	Robert M. Graham.
18·05	2·00	17	3	12	16	S	W	W	J. & B. H. Metcalf.
12·00	...	14	5	10	16	N	W	W	J. E. Pague.
6·50	...	14	5	16	10	NW	NW	NW	Frank Ridgway, Sgt. Sig. Corps.
9·00	3·00	12	1	13	17	NW	NW	NW	Prof. Susan J. Cunningham.
...	...	21	3	9	19	W	W	W	Peter Wood, Sgt. Sig. Corps.
12·55	...	14	5	13	11	...	...	...	Wm. Hunt.
...	...	...	...	...	...	...	...	...	R. L. Haslet.
...	...	...	...	...	...	...	...	...	Miss Mary A. Ricker.
11·00	1·00	14	8	15	8	NW	W	NW	Thomas F. Sloan.
12·00	...	...	...	...	...	...	...	...	Capt. W. C. Kimber.
9·60	·60	14	2	12	17	W	W	W	Prof. W. J. Swigart.
13·10	1·00	11	7	11	13	W	W	W	J. E. Rooney.
19·75	·50	15	3	13	15	NW	W	NW	Prof. S. C. Schmucker.
10·00	1·00	14	6	14	11	W	NW	W	E. E. Weller.
10·59	...	14	9	7	15	W	W	NW	Wm. T. Butt.
15·10	...	13	7	16	8	W	W	W	Wm. H. Kline.
14·60	·50	...	3	17	11	W	W	W	Geo. W. Bowman, A.M., Ph.D.
16·50	3·00	12	6	13	12	NW	NW	NW	H. W. Mullen.
19·80	1·30	15	4	12	15	NW	NW	NW	M. H. Boye.
...	...	...	...	...	...	...	...	...	John C. Wuchter.
19·50	...	12	...	...	...	NW	NW	NW	H. D. Miller, M.D.
24·00	...	13	14	2	15	NE	...	NW	A. W. Betterly.
...	...	...	...	...	...	W	W	W	John S. Gibson, P. M.
19·80	...	18	7	4	25	NW	NW	NW	Prof. S. H. Miller.
...	...	...	...	...	...	...	...	...	Culbertson & Lantz.
16·50	3·00	12	14	6	11	NW	NW	NW	Charles Moore, D.D.S.
22·00	...	13	13	5	11	N	W	W	Lerch & Rice.
12·75	...	11	8	9	14	W	W	W	Frank Mortimer.
...	...	19	4	12	15	NW	NW	NW	Luther M. Dey, Sgt. Sig. Corps.
18·00	...	12	9	7	15	W	W	W	C. L. Peck.
20·25	1·25	20	8	13	10	W	W	NW	E. C. Wagner.
...	...	...	...	...	...	...	...	...	J. M. Boyer,
30·50	3·00	15	6	2	23	NW	NW	NW	W. M. Schrock.
48·60	1·60	21	4	8	19	SW	SW	SW	E. S. Chase.
29·25	·50	20	3	12	16	SW	SW	S	H. D. Deming.
13·50	·90	12	3	16	12	NW	NW	NW	F. O. Whitman.
13·00	3·00	24	3	3	25	SW	SW	SW	Wm. Loveland.
11·40	...	20	5	11	15	W	NW	W	A. L. Runion, M.D.
26·50	1·00	14	5	9	17	NW	NW	NW	Theodore Day.
20·00	...	15	...	...	...	...	...	...	John Torrey.
11·40	·80	18	4	5	22	W	W	NW	Hilary S. Brunot.
16·00	...	14	8	11	12	NW	NW	NW	Benj. M. Hall.
8·00	...	15	12	8	11	NW	NW	NW	Mrs. L. H. Grenewald.

T. F. Townsend, *Sergeant Signal Corps, Assistant.*

	Lewistown.	Greensburg.	Tipton.	Coudersport.	Coopersburg.	Holmeville.	Westtown.	Meadville.
.	. .	. .	. .	. .	'26	. .	'33	'02
.	. .	. .	. .	. .	. .	. .	. .	'02
.	. .	. .	. .	. .	. .	. .	. .	. .
.	. .	'10	'01	'30	. .	. .	. .	'10
.	'15	. .	'37	. .	'05	. .	. .	'10
.	'34	'42	'01	'30	'43	. .	'20	. .
.	. .	. .	. .	. .	. .	. .	. .	. .
.	. .	. .	. .	. .	. .	. .	. .	. .
.	. .	. .	. .	. .	. .	. .	. .	. .
.	. .	. .	. .	. .	. .	. .	. .	. .
.	'25	'83	'25	'30	'60	. .	'33	'59
.	'01	. .	'01	'30	'04	. .	'05	'46
.	'09	'26	'08	'10	'01	. .	. .	'59
.	'59	'47	'55	. .	'82	. .	'89	. .
.	'14	'05	. .	. .	'55	. .	. .	'13
.	'02	'03	. .	'30	. .	. .	. .	'45
.	. .	'05	. .	. .	. .	. .	. .	. .
.	. .	. .	. .	. .	. .	. .	. .	. .
.	1'10	'87	'98	'40	'90	. .	. .	'10
.	. .	. .	. .	. .	. .	. .	'50	. .
.	'18	'45	'32	'80	'35	. .	. .	'45
.	'44	1'01	'53	. .	1'50	. .	1'19	'14
.	'04	'07	. .	. .	'37	. .	. .	. .
.	. .	. .	. .	. .	. .	. .	. .	. .
.	'25	'16	'25	. .	'21	. .	'18	'12
.	'01	. .	. .	'40	'24	. .	. .	. .
.	'01	'10	'10	. .	. .	. .	. .	'02
.	'43	'22	'33	'40	'98	. .	'39	'70
.	. .	'02	'11	'3	. .	. .	. .	'52
.	. .	'31	. .	'30	'06	. .	'02	'30
.	'05	'12	. .	. .	'13	. .	'40	. .
	4'03	5'54	3'90	4'20	7'92	. .	4'68	4'81

T. F. T.

1st, 2d, 3d, 5th, 10th, 15th, 16th, 17th, 19th, 28th, 29th, 30th; Myerstown, 4th, 15th, 16th, 19th, 29th, 30th; Annville, 5th, 6th, 15th, 19th, 29th, 30th, 31st; Centre Valley, 1st, 5th, 6th, 15th, 16th, 19th, 30th, 31st; Coopersburg, 4th, 6th, 15th, 16th, 19th, 29th, 30th, 31st; Drifton, 5th, 6th, 15th, 17th, 19th, 29th; Wilkes-Barre, 4th, 6th, 14th, 19th, 29th, 30th; Nisbet, 4th, 6th, 19th, 29th, 30th, 31st; Greenville, 1st, 2d, 4th, 5th, 6th, 15th, 16th, 17th, 19th, 28th, 29th; Pottstown, 6th, 19th, 31st; Bethlehem, 5th, 6th, 15th, 16th, 19th, 30th, 31st; New Bloomfield, 5th, 15th, 16th; Girardville, 4th, 5th, 6th, 15th, 16th, 19th, 29th, 30th, 31st; Somerset, 1st, 4th, 6th, 14th, 16th, 19th, 29th, 30th; Eagles Mere, 1st, 2d, 4th, 5th, 6th, 14th, 15th, 16th, 17th, 19th, 22d, 23d, 26th, 27th, 28th, 29th, 30th, 31st; Wellsboro, 4th, 5th, 6th, 14th, 15th, 16th, 19th, 22d, 23d, 26th, 28th, 29th, 30th, 31st; Lewisburg, 5th, 6th, 12th, 13th, 14th, 15th, 19th, 30th, 31st; Columbus, 1st, 2d, 3d, 4th, 5th, 11th, 15th, 16th, 23d, 29th, 30th; Cannonsburg, 1st, 2d, 4th, 5th, 6th, 10th, 14th, 15th, 17th, 19th, 31st; Dyberry, 5th, 6th, 14th, 15th, 19th, 23d, 28th, 29th, 30th; South Eaton, 5th, 6th, 15th, 19th; York, 5th, 6th, 15th, 19th, 29th, 31st; Meadville, 1st, 2d, 4th, 5th, 10th, 13th, 14th, 15th, 16th, 17th, 19th, 22d, 23d, 26th, 28th, 29th, 30th.

Frost.—Blue Knob, 1st, 2d, 3d, 4th, 5th, 6th, 7th, 8th, 9th 10th, 31st; Hollidaysburg, 4th, 7th; Tipton, 3d, 5th, 6th, 7th, 8th, 9th, 10th, 20th, 31st; Quakertown, 3d, 4th, 9th, 10th; Emporium, 7th, 8th, 9th, 10th, 15th, 24th, 31st; State College, 4th, 7th, 9th, 10th, 20th, 24th, 31st; Westtown, 4th, 10th; Rimersburg, 7th, 9th; Lock Haven, 4th; Uniontown, 18th, 20th, 24th; Lancaster, 4th; Annville, 4th, 8th, 9th, 10th, 16th, 17th; Coopersburg, 1st, 2d, 3d, 4th, 5th, 6th, 7th, 8th, 9th, 10th, 15th. 16th, 17th, 18th, 19th, 20th, 23d, 24th, 27th, 29th, 31st; Nisbet, 4th, 7th, 9th, 31st; Greenville, 24th; Girardville, 2d, 3d, 4th, 5th, 6th, 7th, 8th, 9th, 10th, 11th, 15th, 16th, 17th, 18th, 19th, 20th, 23d, 24th, 29th, 30th, 31st; Wellsboro, 1st, 2d, 3d, 4th, 5th, 6th, 7th, 8th, 9th, 10th, 11th, 15th, 16th, 17th, 18th, 19th, 20th, 23d, 24th, 25th, 29th, 30th, 31st; Columbus, 1st, 2d, 3d, 4th, 5th, 6th, 7th, 8th, 9th, 10th, 14th, 15th, 16th, 17th, 18th, 19th, 20th, 22d, 23d, 24th, 26th, 27th, 29th, 30th, 31st; South Eaton, 1st, 2d, 3d, 4th, 5th, 6th, 7th, 8th, 9th, 10th, 11th, 15th, 16th, 17th, 18th, 19th, 20th, 23d, 24th, 25th, 27th, 28th, 29th, 30th, 31st; York, 2d 4th, 10th, 27th; Meadville, 24th, 31st.

Sleet.—Tipton, 27th, 31st; Lock Haven, 14th, 19th; Waynesburg, 4th, 5th; Wellsboro, 14th, 22d; Dyberry, 28th.

Aurora.—Eagles Mere, 19th.

Coronæ.—Charlesville, 25th; Myerstown, 3d; Annville, 24th; Greenville, 2d; Dyberry, 3d; Meadville, 23d, 31st.

Solar Halos.—Blue Knob, 27th; Le Roy, 4th, 5th, 6th, 10th, 12th, 20th, 24th, 25th, 27th, 31st; West Chester, 29th; Coatesville, 10th; Nisbet, 5th; Philadelphia, 3d, 5th, 8th, 20th, 27th, 29th, 31st; Eagles Mere, 4th, 5th, 10th, 24th, 27th, 31st; Wellsboro, 4th, 24th, 27th, 31st; Dyberry, 10th, 31st; South Eaton, 31st; Meadville, 20th, 27th, 29th, 31st.

Lunar Halos.—Charlesville, 3d, 30th; Reading, 3d; Wysox, 29th; Le Roy, 29th; Quakertown, 3d; State College, 25th; West Chester 3d; Coatesville, 2d, 3d, 7th; Westtown, 3d; Rimersburg, 7th; Carlisle, 2d, 3d, 6th;

Lancaster, 3d; Annville, 4th; Coopersburg, 3d; Philadelphia, 3d, 30th; Eagles Mere, 28th; Dyberry, 3d, 24th.

Meteors.—State College, 9th.

Parhelias.—Le Roy, 20th, 24th, 31st; West Chester, 29th; Eagles Mere, 24th, 27th, 31st; Dyberry, 24th, 27th, 31st; Meadville, 31st.

Zodiacal Lights.—Coatesville, 8th, 9th.

WEATHER FORECASTS.

Percentage of local verifications of weather and temperature signals as reported by displaymen for March, 1890:

Weather, 82 per cent.
Temperature, 88 per cent.

TEMPERATURE AND WEATHER SIGNAL DISPLAY STATIONS.

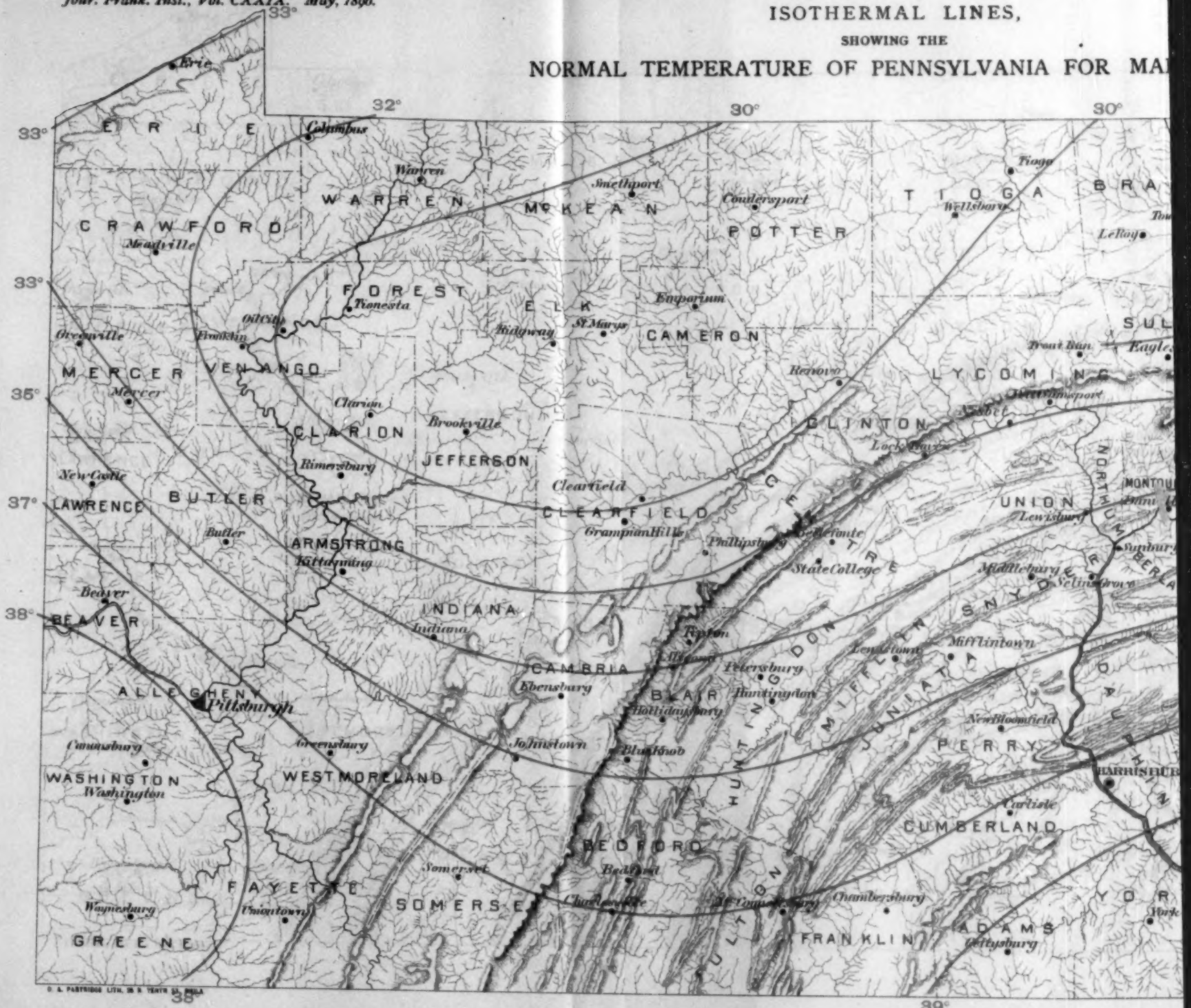
Displayman.	*Station.*
U. S. Signal Office,	Philadelphia.
Wanamaker & Brown,	"
Pennsylvania Railroad Company,	"
Continental Brewing Company,	"
Samuel Simpson,	"
B. T. Babbitt,	"
Western Meat Company,	"
Neptune Laundry,	"
C. W. Burkhart,	Shoemakersville.
A. N. Lindenmuth,	Allentown.
C. B. Whitehead,	Bradford.
Capt. Geo. R. Guss,	West Chester.
Thomas F. Sloan,	McConnellsburg.
J. H. Fulmer,	Muncy.
W. T. Butz,	New Castle.
Capt. A. Goldsmith,	Quakertown.
Postmaster,	Meadville.
Frank Ross,	Oil City.
Lerch & Rice,	Bethlehem.
John W. Aitken,	Carbondale.
Signal Office,	Erie.
J. R. Raynsford,	Montrose.
E. P. Wilbur & Co.,	South Bethlehem.
Agricultural Experiment Station,	State College.
Signal Office,	Pittsburgh.
New Era,	Lancaster.
State Normal School,	Clarion.
Clarion Collegiate Institute,	Rimersburg.
Thiel College,	Greenville.
D. G. Hurley,	Altoona.
J. E. Forsythe,	Butler.

Displayman.	*Station.*
James H. Fones,	Tionesta.
Steward M. Dreher,	Stroudsburg.
State Normal School,	Millersville.
E. C. Wagner,	Girardville.
Hartford P. Brown,	Rochester.
L. H. Grenewald,	York.
J. E. Pague,	Carlisle.
C. L. Peck,	Coudersport.
H. D. Miller,	Drifton.
M. Tannehill,	Confluence.
S. C. Burkholder,	Pollock.
Robt. M. Graham,	Catawissa.
Henry F. Bitner,	Millersville.
A. M. Wildman,	Langhorne.
G. W. Klee,	Chambersburg.
A. Simon's Sons,	Lock Haven.
J. K. M. McGowan,	Lock No. 4.
Raftsman's Journal,	Clearfield.
W. S. Ravenscroft,	Hyndman.
R. C. Schmidt & Co.,	Belle Vernon.
H. W. Mullen,	Centre Valley.
Chas. B. Lutz,	Bloomsburg.
E. C. Lorentz,	Johnstown.
W. M. James,	Ashland.
Miller & Allison,	Punxsutawney.
Dr. A. L. Runion,	Canonsburg.
E. J. Sellers,	Kutztown.
T. F. Heebner,	Scranton.
H. J. Fosnot,	Lewistown.
H. M. Kaisinger,	Hartsville.
E. Jennet,	Franklin.
Milton C. Cooper,	Ashbourne.
Geo. W. Bowman,	Annville.
P. S. Weber,	DuBois.
Foulk & Co.,	Milford.
William Lawton,	Wilmington, Del.
Wister Heberton & Co.,	Germantown.
Charles M. Mullen,	Bedford.
E. W. Merrill,	North East.
A. Simon's Sons,	Lock Haven.
Frank Ridgway,	Harrisburg.

ISOTHERMAL LINES,

SHOWING THE

NORMAL TEMPERATURE OF PENNSYLVANIA FOR MA

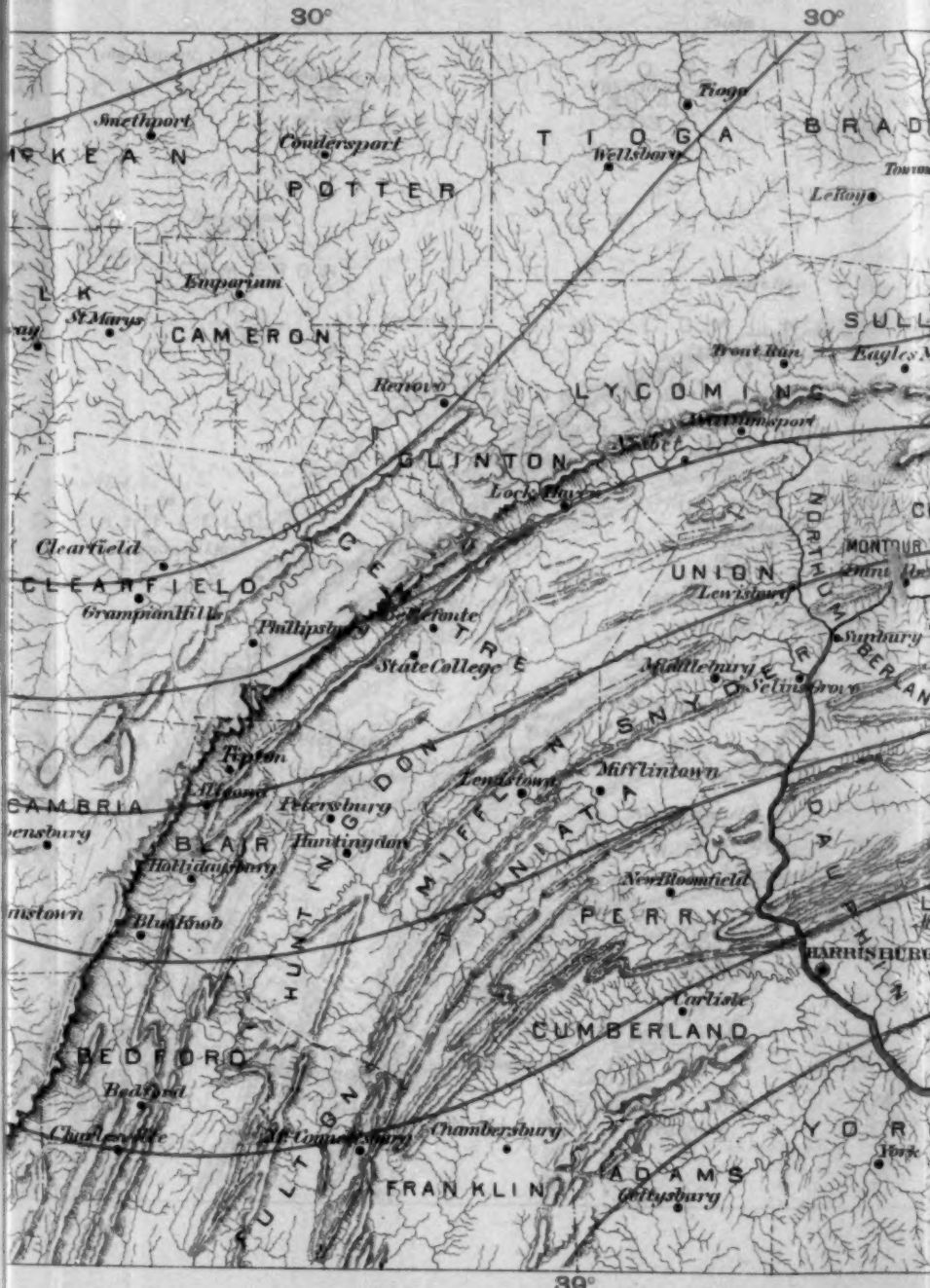


C. A. PARTRIDGE LITH. 28 S. TENTH ST. PHILA

ISOTHERMAL LINES,

SHOWING THE

NORMAL TEMPERATURE OF PENNSYLVANIA FOR MARC



OR MARCH.

30°
BRADFORD
Montrose
SUSQUEHANNA
Towanda
LeRoy
WAYNE
30°
Dyberry
Honesdale
Tunkhannock
South Eaton
SULLIVAN
32°
Eagles Mere
WYOMING
Scranton
Blooming Grove
Milford
PIKE
Wilkesbarre
33°
LUZERNE
COLUMBIA
MONTOUR
Bloomsburg
Danville
Drifton
MONROE
Stroudsburg
35°
CARBON
Sunbury
Mauch Chunk
NORTHAMPTON
Shamokin
Easton
37°
SCHUYLKILL
Pottsville
Lynnport
Bethlehem
LEHIGH
Hamburg
Allentown
Quakertown
39°
LEBANON
BERKS
BUCKS
Lebanon
Reading
Doylestown
38°
MONTGOMERY
Pottstown
Norristown
40°
LANCASTER
CHESTER
Lancaster
West Chester
Westtown
Media
DELAWARE
PHILADELPHIA
Kennett Square
40°

WARREN
CRAWFORD
FOREST
VENANGO
MERCER
CLARION
JEFFERSON
BUTLER
LAWRENCE
ARMSTRONG
INDIANA
BEAVER
ALLEGHENY
WESTMORELAND
WASHINGTON
FAYETTE
SOMERSET
GREENE

PENNSYLVANIA STATE WEATHER SERVICE.

MONTHLY WEATHER REVIEW

FOR APRIL, 1890.

Prepared under the Direction of the Committee on Meteorology of the FRANKLIN INSTITUTE.

HALL OF THE FRANKLIN INSTITUTE,
PHILADELPHIA, April 30, 1890.

TEMPERATURE.

The mean temperature of 67 stations for April, 1890, was 48°·7, which is about 3° above the normal.

The mean of the daily maximum and minimum temperatures 61°·2 and 36°·0 give an average daily range of 25°·2, and a monthly mean of 48°·6.

Highest monthly mean, 53°·7 at Annville.

Lowest monthly mean, 43°·4 at Dyberry and Phillipsburg.

Highest temperature recorded during the month, 85° on 12th, at Lewistown and Lynnport.

Lowest temperature, 12° at Charlesville and Columbus, on the 1st.

Greatest local monthly range, 44°·1 at Somerset.

Least local monthly range, 16°·7 at Eagles Mere.

Greatest daily range, 60° at Ligonier on 17th.

Least daily range, 1° at Annville on 25th.

The warmest day of the month was on the 12th. On this day 25 stations recorded a temperature of over 80°.

The coldest was on the 1st and 2d, when 15 stations recorded a temperature below 20°.

BAROMETER.

The mean pressure for the month 30·12, is about ·12 above the normal.

The highest observed was 30·67 at Philadelphia and Eagles Mere on the 2d.

The lowest was 29·317, at York, on the 18th.

PRECIPITATION.

The average rainfall [including melted snow] was 3·46 inches which is an excess of about three-quarters of an inch. Rain was of almost daily occurrence from the 1st to the 10th, and from the 23d to the 30th inclusive. During the interval of twelve days, from the 10th to the 23d, there was almost a total absence.

The largest totals for the month in inches were Blue Knob, 5·50; Altoona, 5·29; Hollidaysburg, 4·96; Huntingdon, 4·91; Pittsburgh, 4·87; and Columbus, 4·65.

The least were Lynnport, 1·75, and South Eaton, 1·81.

Twenty-four stations reported snow in measurable quantities. The largest total for the month was 3 inches at Mauch Chunk and Centre Valley. None on the ground at the end of the month.

WIND AND WEATHER.

The prevailing wind was from the northwest. The weather was favorable during the entire month for the growth of grass and grain. Very little damage was done by frosts.

MISCELLANEOUS PHENOMENA.

Thunder-storms.—Charlesville, 4th; Blue Knob, 4th, 8th, 29th; Hollidaysburg, 4th, 8th, 9th, 27th; Tipton, 4th, 8th; Le Roy, 4th, 8th, 29th; Forks of Neshaminy, 27th; Quakertown, 7th, 9th; Johnstown, 4th, 8th, 9th, 29th; Emporium, 4th, 8th, 9th, 26th; Mauch Chunk, 7th, 9th; State College, 4th, 8th, 9th, 29th; Phillipsburg, 26th; West Chester, 27th; Coatesville, 7th, 27th; Rimersburg, 8th, 26th, 29th; Lock Haven, 4th, 7th, 8th, 29th; Catawissa, 4th, 8th, 9th; Meadville, 8th, 26th; Carlisle, 8th, 9th; Swarthmore, 7th, 27th; Uniontown, 4th, 8th, 26th; McConnellsburg, 8th, 9th; Huntingdon, 4th, 8th, 9th, 29th; Petersburg, 7th, 8th, 9th, 29th; Indiana, 7th, 8th, 9th, 26th; Lancaster, 24th, 27th; Myerstown, 8th, 9th; Annville, 4th, 8th, 9th; Centre Valley, 9th; Wilkes-Barre, 9th; Nisbet, 29th; Greenville, 8th; Lewistown, 4th, 8th, 9th, 29th; Bethlehem, 4th, 9th; New Bloomfield, 4th, 8th, 9th; Philadelphia, 7th, 27th; Girardville, 8th; Selins Grove, 9th; Somerset, 4th, 7th, 8th, 9th; Eagles Mere, 4th, 8th, 16th, 29th; Wellsboro, 8th; Lewisburg, 9th, 29th; Columbus, 8th, 26th; Cannonsburg, 8th, 9th, 26th; Dyberry, 8th; South Eaton, 8th; Scranton, 8th.

Hail.—Blue Knob, 9th; Tipton, 8th; Quakertown, 9th; Mauch Chunk, 26th; State College, 9th, 26th; Meadville, 8th; Huntingdon, 9th; Petersburg, 9th; Indiana, 10th; Myerstown, 9th; Annville, 9th; Centre Valley, 9th; Coopersburg, 9th; Greenville, 8th; New Bloomfield, 9th; Selins Grove, 9th; Wellsboro, 26th; Dyberry, 8th, 26th; Scranton, 8th.

Snow.—Charlesville, 1st, 11th; Blue Knob, 10th, 11th; Hollidaysburg, 1st, 10th; Tipton, 1st; Quakertown, 1st; Emporium, 1st, 10th; Mauch Chunk, 1st; State College, 1st; West Chester, 1st; Coatesville, 1st; Rimersburg, 10th; Meadville, 10th; Uniontown, 10th, 11th; Lancaster, 1st; Ann-

County.	Station.	Elevation above Sea Level (feet).	Barometer Reduced to Sea Level.			Temperature.												Relative Humidity.
							Maximum.		Minimum.				Daily Range.					
			Mean.	Highest.	Lowest.	Mean.	Highest.	Date.	Lowest.	Date.	Mean of Maximum.	Mean of Minimum.	Mean.	Greatest.	Date.	Least.	Date.	
Adams,[1]	Gettysburg,	624	30·120	30·590	29·670	48·7	83·0	13	21·0	2	56·8	39·6	17·2	48·0	12	2·0	26	. . .
Allegheny,[1]	Pittsburgh,	847	30·120	30·580	29·490	52·6	78·0	13	28·0	1	63·6	41·5	22·1	35·0	3	6·0	24	82·0
Bedford,	Charlesville (29 days),	1,300	. . .	. . .	. . .	44·6	79·0	13	12·0	1	63·5	33·5	30·0	51·0	23	12·0	15	71·1
Berks,[1]	Reading,	304	. . .	. . .	. . .	50·3	83·0	13	19·0	19	63·9	36·7	27·2	43·0	13	6·0	9	. . .
Blair,[2]	Altoona,	1,181	. . .	. . .	. . .	52·7	77·0	14	28·0	2	63·4	42·0	21·4	34·0	5	11·0	27	55·9
Blair,	Blue Knob,	2,500	. . .	. . .	. . .	46·7	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Blair,	Hollidaysburg,	947	. . .	. . .	. . .	49·5	80·0	13	20·0	2	64·0	34·5	29·5	52·0	3	5·0	24	74·0
Blair,	Tipton,	915	. . .	. . .	. . .	48·2	78·0	3	26·0	2	61·8	39·0	22·8	43·0	21	4·0	4	. . .
Bradford,	Wysox (27 days),	718	30·156	30·624	29·476	44·9	80·5	13	15·5	2	58·4	30·8	27·6	49·0	12	11·0	24	69·3
Bradford,	Le Roy,	1,400	. . .	. . .	. . .	45·5	78·0	13	20·0	2	55·1	35·1	20·0	37·0	12	6·0	26	. . .
Bucks,	Forks of Neshaminy,	. . .	. . .	. . .	. . .	50·3	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Bucks,	Quakertown,	536	30·120	30·810	29·580	48·3	81·7	13	21·7	2	60·7	34·8	25·9	45·5	23	5·0	9	67·0
Bucks,	Hulmeville,	120	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Cambria,[1]	Johnstown,	1,184	30·166	30·660	29·400	49·7	75·0	12, 13	23·0	2	60·2	36·9	23·3	43·0	12	6·0	24	79·4
Cameron,	Emporium,	1,030	. . .	. . .	. . .	51·3	81·0	13	18·0	2	62·4	32·5	29·9	49·0	12	8·0	24	. . .
Carbon,[1]	Mauch Chunk,	550	. . .	. . .	. . .	47·7	82·0	13	20·0	2	62·0	34·9	27·1	45·0	13	7·0	9	. . .
Centre,	State College— Agricultural Experiment Station,	1,191	30·079	30·605	29·358	48·5	76·0	12, 13	23·0	1	59·3	36·6	22·7	41·0	12	6·0	26	69·4
Centre,	Phillipsburg,	1,350	. . .	. . .	. . .	43·4	78·0	13	18·0	2	55·0	31·4	23·6	49·0	22	8·0	26	. . .
Chester,	West Chester,	455	30·109	30·616	29·533	50·1	80·0	13	25·0	2	60·7	39·5	21·2	35·0	13	7·0	26	63·0
Chester,	Coatesville,	380	. . .	. . .	. . .	49·5	81·5	13, 14	22·0	2	63·0	36·4	26·6	44·5	23	6·0	26	. . .
Chester,[1]	Kennett Square,	275	. . .	. . .	. . .	42·5	74·0	13	30·0	1	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Chester,	Westtown,	350	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Clarion,	Rimersburg,	1,500	. . .	. . .	. . .	48·2	76·0	13	18·0	1	58·0	38·3	19·7	33·0	2	4·0	7	. . .
Clarion,	Clarion— State Normal School,	1,530	. . .	. . .	. . .	48·4	74·0	12	18·0	1	59·4	25·4	34·0	43·0	3	11·5	24	81·4
Clearfield,	Grampian Hills,	1,450	. . .	. . .	. . .	46·7	76·0	13, 22	14·0	2	59·7	35·0	24·7	44·0	22	4·0	26	. . .
Clinton,	Lock Haven,	560	. . .	. . .	. . .	48·6	84·0	13	20·0	2	60·2	35·3	24·9	43·0	21	7·0	9	. . .
Columbia,	Catawissa (28 days),	491	. . .	. . .	. . .	49·0	77·0	13	25·0	2	60·1	37·5	22·6	39·5	12	3·0	26	. . .
Crawford,	Meadville,	1,300	30·054	30·620	29·170	44·7	73·0	5	17·5	2	57·0	34·0	23·0	35·0	22	7·0	26	73·0
Cumberland,	Carlisle,	480	. . .	. . .	. . .	51·1	82·0	30	24·0	1	65·3	38·2	27·1	41·0	23	7·0	9	80·5
Dauphin,[1]	Harrisburg,	361	30·136	30·640	29·528	51·5	81·0	13	28·0	2	60·8	40·8	20·0	37·0	12	3·0	26	61·5
Delaware,	Swarthmore— Swarthmore College,	190	30·099	30·551	29·578	50·5	79·5	13	24·5	2	60·6	40·9	19·7	35·0	23	4·1	26	70·9
Erie,[1]	Erie,	681	30·100	30·560	29·360	45·0	76·0	12	22·0	2	54·0	37·0	17·0	33·0	8	3·0	24	80·0
Fayette,	Uniontown,	1,000	30·127	30·491	29·528	52·1	79·0	13	28·0	2	63·1	40·5	22·6	43·0	3	4·0	4	. . .
Forrest,	Tionesta,	1,057	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Franklin,[1]	Chambersburg— Wilson Female College (21 days),	618	. . .	. . .	. . .	50·3	82·0	13, 14	24·0	20	65·0	35·6	29·4	52·0	13	7·0	9	. . .
Fulton,	McConnellsburg,	875	. . .	. . .	. . .	51·0	82·0	13	22·0	2	64·4	37·1	27·3	48·0	12	14·0	24	70·5
Greene,	Waynesburg,	750	. . .	. . .	. . .	50·8	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Huntingdon,[1]	Huntingdon— The Normal College,	650	. . .	. . .	. . .	46·2	81·0	13	20·0	3	64·3	37·6	26·7	55·0	3	4·0	5	. . .
Huntingdon,	Petersburg,	700	. . .	. . .	. . .	47·7	81·0	12	20·0	2	63·7	34·1	29·6	48·0	12	5·0	24	. . .
Indiana,	Indiana— State Normal School,	1,350	30·152	30·532	29·565	53·1	75·2	12	18·0	1	61·5	34·9	26·6	47·2	12	9·0	15	70·1
Lancaster,	Lancaster,	413	30·112	30·509	29·611	50·9	79·0	13, 23	19·0	1	61·8	36·2	25·6	44·5	12	7·0	26	70·6
Lawrence,	New Castle,	932	. . .	. . .	. . .	53·1	78·0	12	21·0	2	62·3	34·7	27·6	43·0	6	9·0	26	. . .
Lebanon,	Myerstown (29 days),	474	30·111	30·497	29·508	48·4	81·8	13	22·0	2	62·4	34·6	27·8	45·0	23	9·0	4	76·1
Lebanon,	Annville— Lebanon Valley College,	339	. . .	. . .	. . .	53·7	82·0	13	31·0	2	. . .	. . .	. . .	36·0	12	1·0	25	82·7
Lehigh,	Centre Valley,	348	. . .	. . .	. . .	51·6	84·0	13	30·0	1, 2	64·6	41·4	23·2	38·0	23	3·0	26	. . .
Lehigh,	Coopersburg,	520	. . .	. . .	. . .	50·0	83·0	13	24·0	2	63·4	37·6	25·8	42·0	13	6·0	9	. . .
Lehigh,[1]	Lynnport,	350	. . .	. . .	. . .	48·7	85·0	14	20·0	2	62·5	35·0	27·5	49·0	14	8·0	24	. . .
Luzerne,	Drifton— Drifton Hospital,	1,655	. . .	. . .	. . .	44·5	76·0	17	21·0	2, 19	57·3	34·0	23·3	33·0	12	10·0	26	. . .
Luzerne,	Scranton,	477	. . .	. . .	. . .	47·9	76·0	13, 14	22·0	2	58·9	36·9	22·0	37·0	12	7·0	1	61·5
Luzerne,[1]	Wilkes-Barre,	575	. . .	. . .	. . .	49·8	83·0	13	22·0	2	63·7	36·0	27·7	48·0	12	14·0	4	. . .
Lycoming,[1]	Nisbet,	550	. . .	. . .	. . .	47·0	82·0	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Mercer,[1]	Greenville— Thiel College,	1,000	30·077	30·578	29·366	44·6	75·5	12	20·0	1	59·5	34·1	25·4	36·7	3	9·1	24	84·9
Mifflin,	Lewistown,	500	. . .	. . .	. . .	51·9	85·0	13	23·0	2	66·1	36·5	29·6	53·0	12	9·0	24	69·4
Montgomery,	Pottstown,	150	. . .	. . .	. . .	51·7	83·0	13	28·0	1	63·0	40·0	23·0	41·0	12	4·0	25	70·0
Northampton,	Bethlehem,	360	30·087	30·541	29·519	52·5	83·0	13	26·0	1	62·0	38·0	24·0	43·0	23	5·0	9	67·0
Perry,	New Bloomfield,	400	. . .	. . .	. . .	48·6	82·0	13	20·0	2	59·7	38·1	21·6	48·0	3	3·0	4	. . .
Philadelphia,[1]	Philadelphia— Signal Office,	117	30·132	30·670	29·480	52·0	81·0	13	30·0	1	61·4	42·7	18·7	39·0	13	5·0	9	61·0
Potter,	Coudersport,	1,670	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Schuylkill,	Girardville,	1,000	30·105	30·534	29·556	48·5	77·0	13	22·0	2	59·3	34·5	24·8	38·0	12	8·0	4	. . .
Snyder,	Selins Grove,	445	. . .	. . .	. . .	51·8	82·0	13	25·0	1	63·7	37·2	26·5	39·0	23	12·0	9	70·9
Somerset,	Somerset,	2,250	. . .	. . .	. . .	47·0	76·0	13	21·0	1	73·3	29·2	44·1	51·0	23	8·0	24	77·0
Sullivan,	Eagles Mere,	2,060	30·181	30·674	29·668	43·6	74·0	13	20·0	2, 19	51·4	34·7	16·7	27·0	3	6·0	4	64·3
Tioga,	Wellsboro,	1,327	30·069	30·501	29·519	44·5	82·0	13	20·0	2, 16	54·8	33·7	21·1	42·0	3	8·0	9	69·2
Union,[1]	Lewisburg,	450	. . .	. . .	. . .	50·8	84·0	13	22·0	2	64·6	37·0	27·6	43·0	13	8·0	9	. . .
Warren,	Columbus,	1,410	. . .	. . .	. . .	45·2	76·0	12	12·0	1, 2	58·2	32·0	26·2	48·0	22	2·0	7	64·5
Washington,	Canonsburg,	950	30·092	30·503	29·362	51·2	80·0	12	23·0	2	64·1	36·1	28·0	43·0	22	8·0	15	73·1
Wayne,	Dyberry,	1,100	. . .	. . .	. . .	43·4	79·0	13	16·0	2	56·3	30·0	26·3	47·0	12	5·0	4	. . .
Wayne,	Honesdale,	1,000	. . .	. . .	. . .	45·4	77·0	23	19·0	2	57·4	33·4	24·0	44·0	23	9·0	9	56·7
Westmoreland,	Greensburg,	1,175	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Westmoreland,	Ligonier,	1,750	. . .	. . .	. . .	51·0	87·0	17	19·0	2	66·0	34·0	32·0	60·0	17	12·0	24	73·0
Wyoming,[1]	South Eaton	660	. . .	. . .	. . .	44·6	80·0	13	19·0	2	58·9	34·3	24·6	44·0	12	11·0	4	. . .
York,[1]	York,	385	30·067	30·420	29·317	50·1	82·0	13	23·0	2	64·2	36·9	27·3	42·0	23	7·0	26	71·1

[1] Observations taken at 8 A. M. and 8 P. M. [illegible]

Temperature.												Relative Humidity.	Dew Point.	Total Inches.
Maximum.		Minimum.		Mean of Maximum.	Mean of Minimum.	Daily Range.								
Highest.	Date.	Lowest.	Date.			Mean.	Greatest.	Date.	Least.	Date.				
83·0	13	21·0	2	56·8	39·6	17·2	48·0	12	2·0	26	. . .	. . .	. . .	3·1
78·0	13	28·0	1	63·6	41·5	22·1	35·0	3	6·0	24	82·0	46·4	4·8	
79·0	13	12·0	1	63·5	33·5	30·0	51·0	23	12·0	15	72·1	38·8	2·7	
83·0	13	19·0	19	63·9	36·7	27·2	43·0	13	6·0	9	. . .	. . .	2·6	
77·0	14	28·0	2	63·4	42·0	21·4	34·0	5	11·0	27	55·9	37·0	5·2	
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	5·5
80·0	13	20·0	2	64·0	34·5	29·5	52·0	3	5·0	24	74·0	41·0	4·9	
78·0	3	26·0	2	61·8	39·0	22·8	43·0	21	4·0	4	. . .	. . .	4·8	
80·5	13	15·5	2	58·4	30·8	27·6	49·0	12	11·0	24	69·3	34·5	3·4	
78·0	13	20·0	2	55·1	35·1	20·0	37·0	12	6·0	26	. . .	. . .	3·1	
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	2·9
81·7	13	21·7	2	60·7	34·8	25·9	45·5	23	5·0	9	67·0	36·5	3·1	
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	
75·0	12, 13	23·0	2	60·2	36·9	23·3	43·0	12	6·0	24	79·4	40·0	4·6	
81·0	13	18·0	2	62·4	32·5	29·9	49·0	12	8·0	24	. . .	. . .	3·9	
82·0	13	20·0	2	62·0.	34·9	27·1	45·0	13	7·0	9	. . .	. . .	3·4	
76·0	12, 13	23·0	1	59·3	36·6	22·7	41·0	12	6·0	26	69·4	37·7	3·7	
78·0	13	18·0	2	55·0	31·4	23·6	49·0	28	8·0	26	. . .	. . .	3·5	
80·0	13	25·0	2	60·7	39·5	21·2	35·0	13	7·0	26	63·0	37·5	3·1	
81·5	13, 14	22·0	2	63·0	36·4	26·6	44·5	23	6·0	26	. . .	. . .	2·5	
74·0	13	30·0	1	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	2·7
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	
76·0	13	18·0	1	58·0	38·3	19·7	33·0	2	4·0	7	. . .	. . .	. . .	
74·0	12	18·0	1	59·4	25·4	34·0	43·0	3	11·5	24	81·4	42·5	. . .	
76·0	13, 22	14·0	2	59·7	35·0	24·7	44·0	22	4·0	26	. . .	. . .	3·1	
84·0	13	20·0	2	60·2	35·3	24·9	43·0	21	7·0	9	. . .	. . .	4·1	
77·0	13	25·0	2	60·1	37·5	22·6	39·5	12	3·0	26	. . .	. . .	2·5	
73·0	5	17·5	2	57·0	34·0	23·0	35·0	22	7·0	26	73·0	35·3	4·4	
82·0	30	24·0	1	65·3	38·2	27·1	41·0	23	7·0	9	80·5	43·5	3·7	
81·0	13	28·0	2	60·8	40·8	20·0	37·0	12	3·0	26	61·3	37·4	2·4	
79·5	13	24·5	2	60·6	40·9	19·7	35·0	23	4·1	26	70·9	40·4	2·2	
76·0	12	22·0	2	54·0	37·0	17·0	33·0	8	3·0	24	80·0	34·0	1·1	
79·0	13	28 o	2	63·1	40·5	22·6	43·0	3	4·0	4	. . .	. . .	3·3	
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	
82·0	13, 14	24·0	20	65·0	35·6	29·4	52·0	13	7·0	9	. . .	. . .	1·3	
82·0	13	22·0	2	64·4	37·1	27·3	48·0	12	14·0	24	70·5	39·6	3·3	
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	2·3
81·0	13	20·0	3	64·3	37·6	26·7	55·0	3	4·0	5	. . .	. . .	4·3	
81·0	12	20·0	2	63·7	34·1	29·6	48·0	12	5·0	24	. . .	. . .	4·1	
75·2	12	18·0	1	61·5	34·9	26·6	47·2	12	9·0	15	70·1	40·6	4·1	
79·0	13, 23	19·0	1	61·8	36·2	25·6	44·5	12	7·0	26	70·6	42·3	2·3	
78·0	12	21·0	2	60·3	34·7	27·6	43·0	6	9·0	26	. . .	. . .	3·1	
81·8	13	22·0	2	62·4	34·6	27·8	45·0	23	9·0	4	76·1	39·6	3·1	
82·0	13	31·0	2	. . .	. . .	. . .	36·0	12	1·0	25	82·7	48·4	. . .	
84·0	13	30·0	1, 2	64·6	41·4	23·2	38·0	23	3·0	26	. . .	. . .	3·1	
83·0	13	24·0	2	63·4	37·6	25·8	42·0	13	6·0	9	. . .	. . .	3·1	
85·0	14	20·0	2	62·5	35·0	27·5	49·0	14	8·0	24	. . .	. . .	1·7	
76·0	17	21·0	2, 19	57·3	34·0	23·3	33·0	12	10·0	26	. . .	. . .	3·1	
76·0	13, 14	22·0	2	58·9	36·9	22·0	37·0	12	7·0	1	61·5	38·2	2·1	
83·0	13	22·0	2	63·7	36·0	27·7	48·0	12	14·0	4	. . .	. . .	2·1	
82·0	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	3·1	
75·5	12	20·0	1	59·5	34·1	25·4	36·7	3	9·1	24	84·9	40·1	4·1	
85·0	13	23·0	2	66·1	36·5	29·6	53·0	12	9·0	24	69·4	42·4	3·1	
83·0	13	28·0	1	63·0	40·0	23·0	41·0	12	4·0	25	70·0	40·0	1·1	
83·0	13	26·0	1	62·0	38·0	24·0	43·0	23	5·0	9	67·0	41·0	2·1	
82·0	13	20·0	2	59·7	38·1	21·6	48·0	3	3·0	4	. . .	. . .	2·1	
81·0	13	30·0	1	61·4	42·7	18·7	39·0	13	5·0	9	61·0	36·0	2·1	
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	
77·0	13	22·0	2	59·3	34·5	24·8	38·0	12	8·0	4	. . .	. . .	4·1	
82·0	13	25·0	1	63·7	37·2	26·5	39·0	23	12·0	9	70·9	40·3	4·1	
76·0	13	21·0	1	73·3	29·2	44·1	51·0	23	8·0	24	77·0	39·0	3·1	
74·0	13	20·0	2, 19	51·4	34·7	16·7	27·0	3	6·0	4	64·3	31·2	4·1	
82·0	13	20·0	2, 18	54·8	33·7	21·1	42·0	3	8·0	9	69·2	30·4	4·1	
84·0	13	22·0	2	64·6	37·0	27·6	43·0	13	8·0	9	. . .	. . .	3·1	
76·0	12	12·0	1, 2	58·2	32·0	26·2	48·0	28	2·0	7	64·5	29·9	4·1	
80·0	12	23·0	2	64·7	36·1	28·0	43·0	22	8·0	15	73·1	48·0	4·1	
79·0	13	16·0	2	56·3	30·0	26·3	47·0	12	5·0	4	. . .	. . .	2·1	
77·0	23	19·0	2	57·4	33·4	24·0	44·0	23	9·0	9	58·7	39·0	2·1	
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	
87·0	17	19·0	2	66·0	34·0	32·0	60·0	17	12·0	24	73·0	44·0	3·1	
80·0	13	19·0	2	58·9	34·3	24·6	44·0	12	11·0	4	. . .	. . .	1·1	
82·0	13	23·0	2	64·2	36·9	27·3	42·0	23	7·0	26	71·1	39·8	1·1	

Dew Point.	Precipitation.				Number of Days.			Wind.			Observers.
	Total Inches.	Total Snowfall During Month.	Depth of Snow on Ground at End of Month.	Number of Days Rainfall.	Clear.	Fair.	Cloudy.	Prevailing Direction. 7 A. M.	2 P. M.	9 P. M.	
. . .	3'31	. . .	. . .	11	19	1	10	S	SW	S	Prof. E. S. Breidenbaugh.
46°4	4'67	. . .	. . .	14	11	7	12	N	N	N	Oscar D. Stewart, Sgt. Sig. Corps.
38°8	2'74	'25	. . .	8	14	7	8	N	N	NW	Miss E. A. G. Apple.
. . .	2'68	. . .	. . .	7	18	5	7	NW	NW	NW	C. M. Dechant, C.E.
37°0	5'89	. . .	. . .	13	. . .	. . .	. . .	. . .	. . .	. . .	Dr. Charles B. Dudley.
. . .	5'50	'50	. . .	12	9	10	11	NW	NW	NW	A. H. Boyle.
41°0	4'06	1'00	. . .	9	15	8	7	W	W	W	Prof. J. A. Stewart.
. . .	4'89	. . .	. . .	10	13	9	8	W	W	W	Miss Cora J. Wilson.
34°5	3'42	. . .	. . .	8	16	3	8	NW	NW	NW	Charles Beecher.
. . .	3'26	. . .	. . .	9	12	11	7	SW	N	N	Geo. W. T. Warburton.
. . .	2'91	. . .	. . .	11	18	8	4	W	NW	W	J. C. Hilsman.
36°5	3'22	2'50	. . .	10	12	12	6	NE	SW	SW	J. L. Heacock.
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	Lewis P. Townsend.
40°0	4'66	. . .	. . .	13	15	6	9	SE	SE	SE	E. C. Lorentz.
. . .	3'98	. . .	. . .	10	12	11	7	W	W	W	T. B. Lloyd.
. . .	3'45	3'00	. . .	10	15	10	5	NW	NW	NW	John J. Boyd.
37°7	3'75	'20	. . .	10	11	9	10	W	W	W	Prof. Wm. Frear.
. . .	3'97	'50	. . .	13	. . .	. . .	. . .	SW	SW	SW	Geo. H. Dunkle.
37°5	3'15	1'75	. . .	11	19	3	8	NW	NW	S	Jesse C. Green, D.D.S.
. . .	2'39	1'75	. . .	10	12	11	7	NW	S	S	W. T. Gordon.
. . .	2'73	. . .	. . .	9	14	9	7	N	. . .	S	Benj. P. Kirk.
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	Prof. Wm. F. Wickersham.
. . .	. . .	. . .	. . .	12	13	8	9	W	W	SW	Rev. W. W. Deatrick, A.M.
42°5	. . .	. . .	. . .	. . .	. . .	. . .	. . .	SW	SW	SW	C. M. Thomas, B.S.
. . .	3'39	. . .	. . .	11	8	13	9	SW	SW	W	Nathan Moore.
. . .	4'22	. . .	. . .	11	19	5	6	W	W	W	Prof. John A. Robb.
. . .	2'92	. . .	. . .	8	. . .	. . .	. . .	. . .	. . .	. . .	Robert M. Graham.
35°3	4'43	. . .	. . .	11	13	9	8	S	S	S	J. & B. H. Metcalf.
43°5	3'19	. .	. . .	11	11	10	9	SW	S	NW	J. E. Pague.
37°4	2'46	. . .	. . .	9	12	12	6	SW	SW	SW	Frank Ridgway, Sgt. Sig. Corps.
40°4	2'88	. . .	. . .	7	3	14	13	NW	NW	NW	Prof. Susan J. Cunningham.
34°0	3'16	. . .	. . .	13	11	8	11	NE	NE	NE	Peter Wood, Sgt. Sig. Corps.
. . .	3'90	. . .	. . .	11	16	9	5	W	SW	SW	Wm. Hunt.
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	R. L. Haslet.
. . .	1'55	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	Miss Mary A. Ricker.
39°6	3'38	. . .	. . .	8	15	8	7	N	W	W	Thomas F. Sloan.
. . .	2'90	. . .	. . .	8	16	4	10	. . .	. . .	. . .	Capt. W. C. Kimber.
. . .	4'91	. . .	. . .	11	11	9	10	W	W	W	Prof. W. J. Swigart.
. . .	4'11	. . .	. . .	10	17	5	8	E	W	W	J. E. Rooney.
40°6	4'66	. . .	. . .	12	15	5	10	NW	NW	W	Prof. S. C. Schmucker.
42°3	2'93	1'00	. . .	9	13	10	7	E	NW	NW	E. E. Weller.
. . .	3'82	. . .	. . .	9	15	5	10	W	S	SW	Wm. T. Butz.
39°6	3'39	2'00	. . .	11	16	3	10	W	W	W	Wm. H. Kline.
48°4	. . .	2'00	. . .	. . .	10	13	7	NW	W	W	Geo. W. Bowman, A.M., Ph.D
. . .	3'17	3'00	. . .	10	13	12	5	SW	NW	SE	H. W. Mullen.
. . .	3'21	1'70	. . .	9	12	10	8	SE	NW	SE	M. H. Boye.
. . .	1'75	. . .	. . .	. . .	18	3	9	. . .	. . .	. . .	John C. Wuchter.
. . .	3'25	. . .	. . .	8	12	13	5	NW	NW	NW	H. D. Miller, M.D.
38°2	2'85	'10	. . .	14	10	10	10	N	. . .	W	C. A. Hinsdell.
. . .	2'62	2'00	. . .	10	19	2	9	NE	NE	NE	A. W. Betterly.
. . .	3'90	. . .	. . .	8	21	3	6	W	W	W	John S. Gibson, P. M.
40°1	4'57	. . .	. . .	12	9	7	14	S	. . .	N	Prof. S. H. Miller.
42°4	3'66	'70	. . .	11	13	9	8	SW	SW	NW	Culbertson & Lantz.
40°0	1'97	. . .	. . .	5	22	3	5	NW	SW	SW	Charles Moore, D.D.S.
41°0	2'57	. . .	. . .	5	23	1	7	W	W	W	Lerch & Rice.
. . .	3'47	. . .	. . .	9	13	7	10	N	N	W	Frank Mortimer.
36°0	2'28	. . .	. . .	10	10	11	9	NW	NW	NW	Luther M. Dey, Sgt. Sig. Corps.
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	C. L. Peck.
. . .	4'40	'75	. . .	11	16	8	6	W	NW	W	E. C. Wagner.
40°5	4'11	1'00	. . .	10	7	20	3	NW	SE	SE	J. M. Boyer,
39°0	3'16	'30	. . .	9	15	9	6	NW	NW	NW	W. M. Schrock.
31°2	4'23	'25	. . .	9	13	10	7	SW	SW	SW	E. S. Chase.
30°4	4'03	. . .	. . .	12	11	13	6	N	N	SW	H. D. Deming.
. . .	3'54	. . .	. . .	7	8	16	6	SW	SW	SW	F. O. Whitman.
29°9	4'05	. . .	. . .	14	13	7	11	SW	SW	SW	Wm. Loveland.
48°0	4'24	. . .	. . .	12	9	9	12	W	W	SW	A. L. Runion, M.D.
. . .	2'53	1'00	. . .	9	13	8	9	NW	NW	NW	Theodore Day.
39°0	2'87	1'00	. . .	10	. . .	. . .	. . .	. . .	. . .	. . .	John Torrey.
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	Hilary S. Brunot.
44°0	3'28	. . .	. . .	10	. . .	. . .	. . .	. . .	. . .	. . .	J. T. Ambrose.
. . .	1'81	. . .	. . .	12	16	7	7	S	S	S	Benj. M. Hall.
39°8	1'94	1'50	. . .	10	19	3	8	NW	NW	NW	Mrs. L. H. Grenewald.

T. F. Townsend, *Sergeant Signal Corps, Assistant.*

Highest.	New Bloomfield.	Wellsboro.	Charlesville.	Lynsport.	Tionesta.	Gettysburg.	Lewistown.	Greensburg.	Tipton.	Coudersport.	Coopersburg.	Holmesville.	Westtown.	Meadville.	Ligonier.	Scranton.
83	..	..	..	..	..	..	.07	..	.02	..	.16	..	..	..	..	.10
78	..	..	..	..	..	..	..	..	..	..	..	..	..	.15	..	..
79	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
83	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
77	.93	.66	.64	..	..	1.41	.64	..	.75	..	1.05	..	..	.87	..	.52
80	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.11
78	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
81	.07	.05	..	..	..	.05	.16	..	.23	..	.33	..	..	.17	..	.21
75	.27	2.76	.34	..	..	.15	.43	..	.75	..	.18	..	..	.88	.37	.40
82	1.27	.05	.69	..	..	.17	1.30	..	1.05	..	.87	..	..	.20	1.35	.70
73	..	..	..	..	..	.01	..	..	..	..	..	..	..	..	.12	..
82	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.01	.03
81	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
79	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
76	..	..	.01	..	..	..	..	..	..	..	..	..	..	.02	.08	..
79	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
82	..	..	..	..	..	.04	..	..	..	..	..	..	..	..	..	..
82	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
81	..	..	..	..	..	.01	.01	..	..	..	..	..	..	.02	..	.06
81	.35	.16	.32	..	..	.40	.19	..	.55	..	.08	..	..	.60	.35	.20
	.22	..	.15	..	..	.46	.10	..	.05	..	.33	..	..	..	..	.06
75	.24	.20	..	..	..	.36	.16	..	1.01	..	.10	..	..	1.07	.52	.14
79	.15	.12	.67	..	..	.25	.24	..	.40	..	.11	..	..	.38	.55	.21
78	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.01	.01
81	.07	.03	..	..	..	..	.35	..	.08	..	..	..	..	.07	..	.10
82	..	..	.01	..	..	..	.01	..	..	..	..	..	..	..	.02	..
82	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
82	3.47	4.03	.74	1.75	..	3.31	3.66	..	4.89	..	3.21	..	..	4.43	3.38	2.85

T. F. T.

ville, 1st; Wilkes-Barre, 2d; Greenville, 10th, 11th; Lewistown, 10th; Eagles Mere, 11th, 26th; Wellsboro, 20th; Columbus, 10th, 11th; Dyberry, 1st, 11th; Honesdale, 1st; York, 1st; Scranton, 1st.

Frost.—Gettysburg, 2d, 17th, 18th, 19th, 20th, 21st; Charlesville, 3d, 6th, 12th, 20th, 21st, 22d; Blue Knob, 1st, 2d, 5th, 6th, 11th, 16th, 17th, 18th, 19th, 20th, 21st; Hollidaysburg, 2d, 3d, 6th 12th. 16th, 17th, 18th, 20th, 21st, 22d; Tipton, 2d, 3d, 6th, 12th, 16th, 17th, 18th, 19th, 20th, 21st; Quakertown, 2d, 3d, 6th, 12th, 16th, 17th, 18th, 20th, 21st, 22d, 23d, 26th, 29th; Emporium, 1st, 2d, 6th, 12th, 16th, 17th, 20th, 21st, 22d; Mauch Chunk, 29th; State College, 2d, 3d, 6th, 16th, 17th, 18th, 20th; Phillipsburg, 17th; Coatesville, 2d, 3d, 8th, 12th, 17th, 20th, 21st; Rimersburg, 17th; Lock Haven, 1st, 2d, 16th, 17th, 18th, 19th, 20th, 28th; Catawissa, 12th, 17th, 18th, 21st; Meadville, 2d, 16th, 17th, 18th, 19th, 20th, 21st, 28th; Carlisle, 17th; Uniontown, 2d, 3d, 18th, 19th, 20th, 21st, 28th; McConnellsburg, 2d, 3d, 6th, 12th, 17th, 20th, 21st, 22d; Huntingdon, 2d, 3d, 6th, 11th, 12th, 13th, 16th, 17th, 18th, 19th, 20th, 21st, 22d, 29th; Petersburg, 2d, 3d, 12th, 16th, 17th, 19th, 20th, 21st; Indiana, 1st; Myerstown, 17th; Annville, 2d, 3d, 17th, 20th, 21st, 29th; Coopersburg, 1st, 2d, 6th, 19th; Nisbet, 2d, 3d, 6th, 8th, 12th, 16th, 17th, 18th, 20th, 21st, 29th; Greenville, 16th, 17th, 19th, 20th, 21st; Lewistown, 2d, 3d; Bethlehem, 1st, 2d, 18th, 19th, 21st; New Bloomfield, 2d, 3d, 6th, 9th, 12th, 17th, 18th, 20th, 21st; Girardville, 1st, 2d, 3d, 5th, 6th, 8th, 11th, 17th, 19th, 25th; Selins Grove, 2d, 3d, 6th, 16th, 17th, 18th, 19th, 20th, 21st, 22d, 28th; Eagles Mere, 6th, 8th, 28th; Wellsboro, 1st, 2d, 3d, 6th, 11th, 16th, 17th, 18th, 19th, 20th, 21st; Columbus, 1st, 2d, 3d, 5th, 6th, 8th, 10th, 11th, 15th, 16th, 17th, 18th, 19th, 20th, 21st, 22d; Canonsburg, 19th, 20th, 21st; Dyberry, 1st, 2d, 3d, 5th, 6th, 8th, 11th, 12th, 13th, 15th, 16th, 17th, 18th, 19th, 20th, 21st, 25th, 26th, 29th; South Eaton, 1st, 2d, 3d, 5th, 6th, 8th, 11th, 12th, 16th, 17th, 19th, 20th, 21st, 29th; York, 2d, 6th, 17th, 20th, 21st.

Sleet.—Le Roy, 26th; Blue Knob, 9th; Wellsboro, 26th.

Aurora.—Greenville, 8th.

Coronæ.—Meadville, 2d; Annville, 3d; Greenville, 25th; Lewistown, 6th, 7th, Eagles Mere, 6th; Dyberry, 3d, 26th.

Solar Halos.—Charlesville, 22d; Le Roy, 2d, 6th, 15th, 21st, 22d, 29th, 30th; Lock Haven, 2d; Meadville, 2d, 15th, 17th, 22d, 25th; Petersburg, 23d; Greenville, 2d, 25th; Philadelphia, 1st, 8th, 15th, 23d; Eagles Mere, 6th, 15th, 21st, 22d, 23d; Wellsboro, 15th; Dyberry, 6th, 15th, 21st, 22d, 23d, 30th.

Lunar Halos.—Charlesville, 2d; Coatesville, 3d; Rimersburg, 7th; Meadville, 28th; Uniontown, 1st; Centre Valley, 3d; Philadelphia, 3d, 29th; Girardville, 1st, 2d, 7th, 8th.

Meteors.—State College, 6th; Coopersburg, 28th; Eagles Mere, 2d.

Parhelias.—Charlesville, 6th; Le Roy, 2d, 16th; Meadville, 2d; Greenville, 2d; Eagles Mere, 16th; Dyberry, 6th, 8th, 16th.

Zodiacal Lights.—Charlesville, 7th, 11th; Le Roy, 20th.

WEATHER FORECASTS.

Percentage of local verifications of weather and temperature signals as reported by displaymen for April, 1890:

Weather, 83 per cent.
Temperature, 89 per cent.

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Continental Brewing Company,	"
Samuel Simpson,	"
B. T. Babbitt,	"
Western Meat Company,	"
Neptune Laundry,	"
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A. N. Lindenmuth,	Allentown.
C. B. Whitehead,	Bradford.
Capt. Geo. R. Guss,	West Chester.
Thomas F. Sloan,	McConnellsburg.
J. H. Fulmer,	Muncy.
W. T. Butz,	New Castle.
Capt. A. Goldsmith,	Quakertown.
Postmaster,	Meadville.
Frank Ross,	Oil City.
Lerch & Rice,	Bethlehem.
John W. Aitken,	Carbondale.
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J. R. Raynsford,	Montrose.
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Agricultural Experiment Station,	State College.
Signal Office,	Pittsburgh.
New Era,	Lancaster.
State Normal School,	Clarion.
Clarion Collegiate Institute,	Rimersburg.
Thiel College,	Greenville.
D. G. Hurley,	Altoona.
J. E. Forsythe,	Butler.
James H. Fones,	Tionesta.
Steward M. Dreher,	Stroudsburg.
State Normal School,	Millersville.
E. C. Wagner,	Girardville.
Hartford P. Brown,	Rochester.
L. H. Grenewald,	York.
J. E. Pague,	Carlisle.

Displayman.	*Station.*
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Frank Ridgway,	Harrisburg.
G. W. Yost,	Collegeville.

44°
46°
48°
50°
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G

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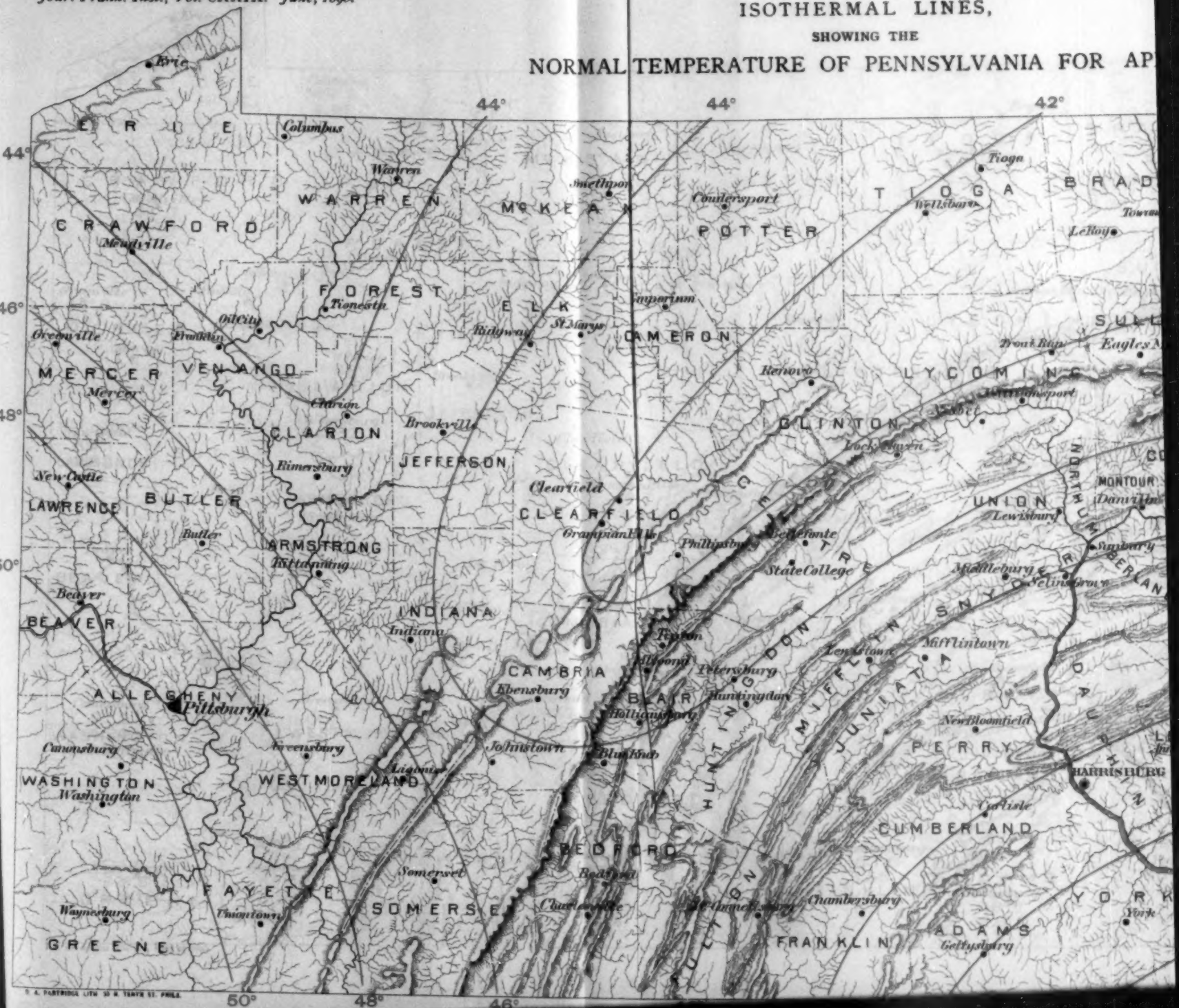

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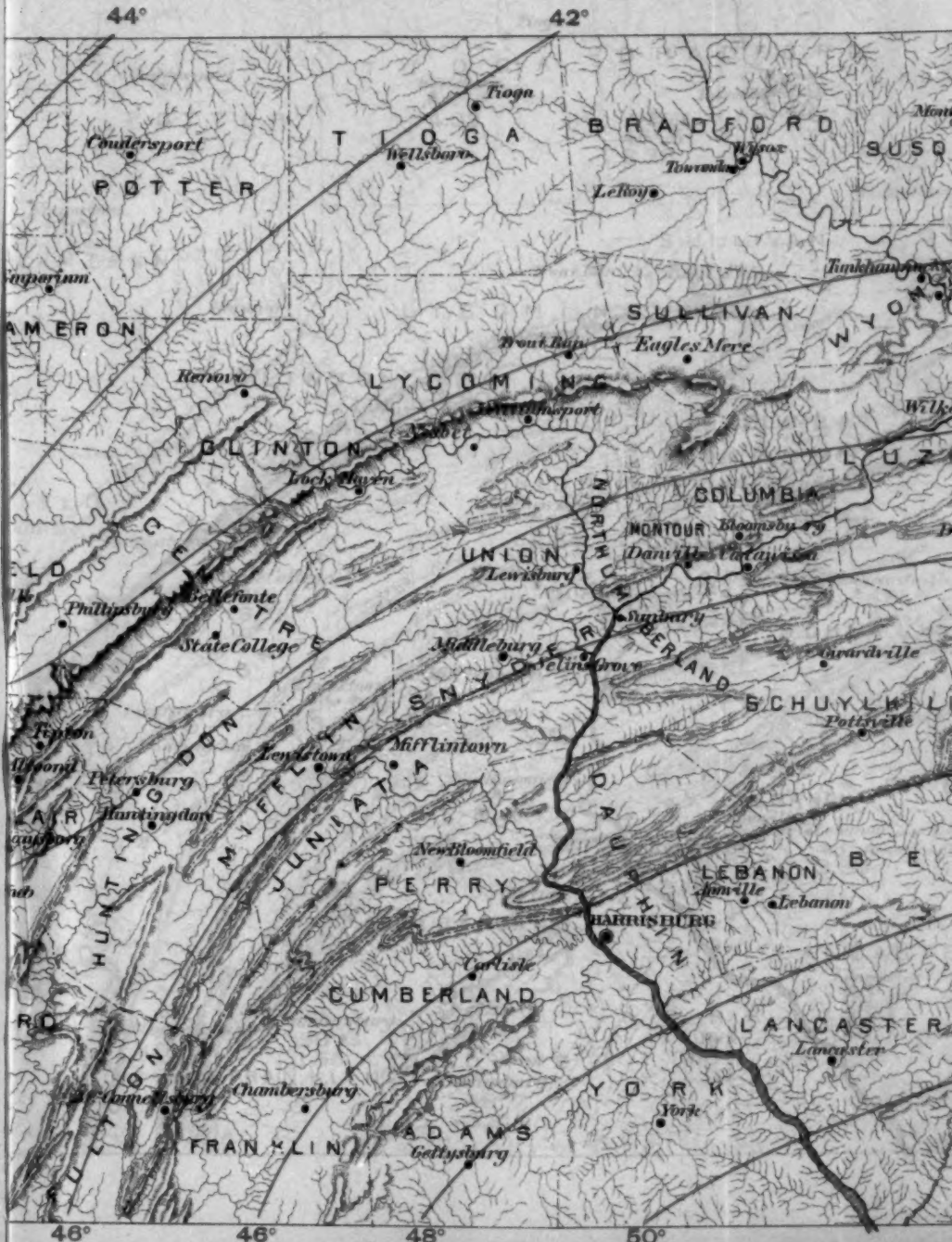

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44°
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LUZERNE
MONROE
Stroudsburg
46°
CARBON
Mauch Chunk
NORTHAMPTON
Easton
Lynnport
Bethlehem
46°
LEHIGH
Allentown
Centre Valley
Quakertown
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BUCKS
Doylestown
MONTGOMERY
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Norristown
CHESTER
West Chester
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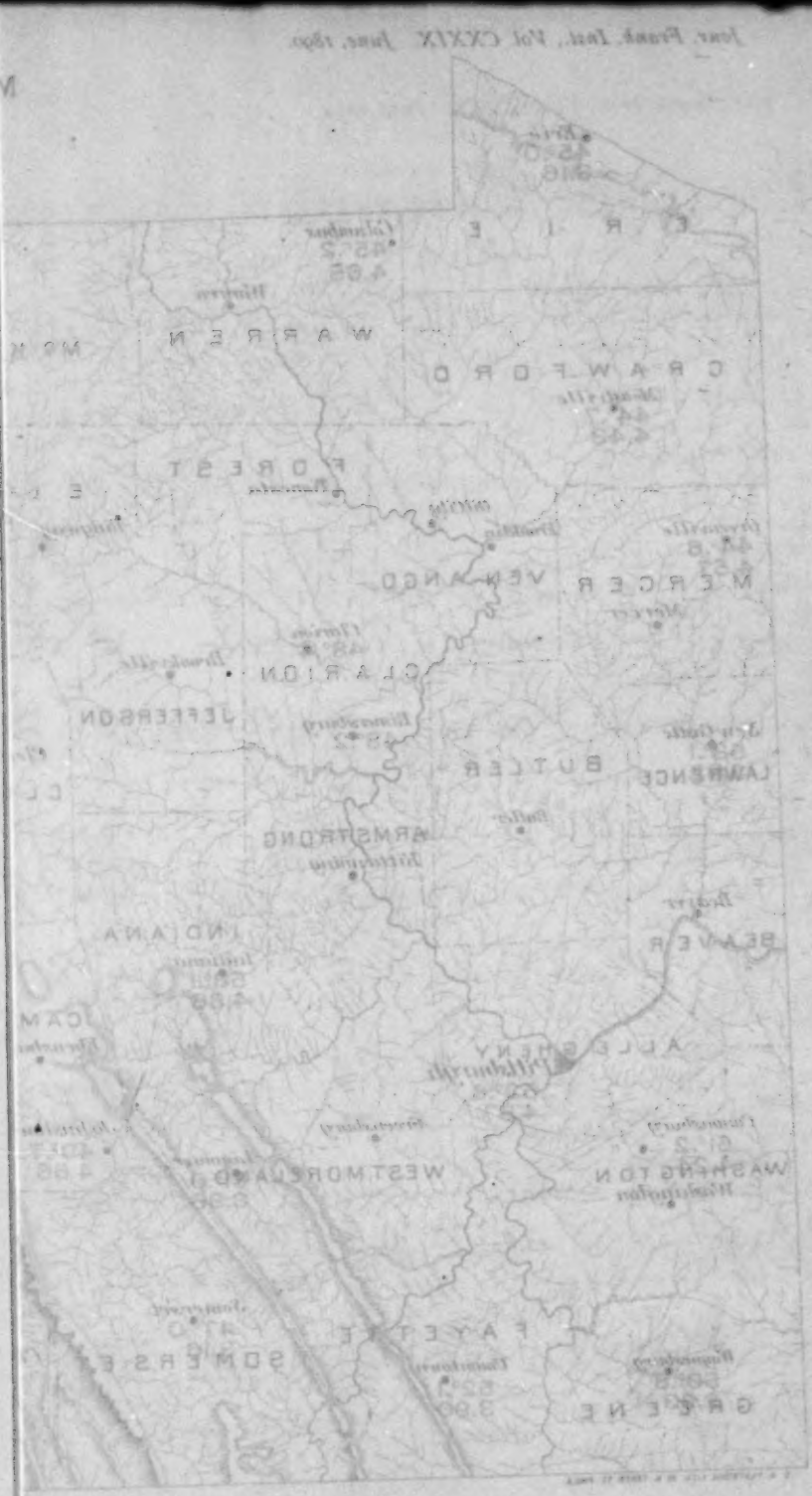
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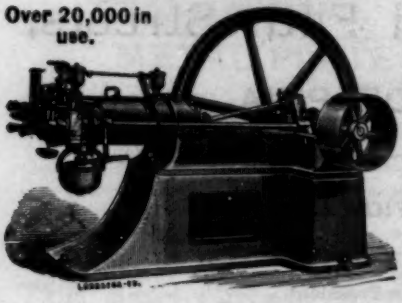

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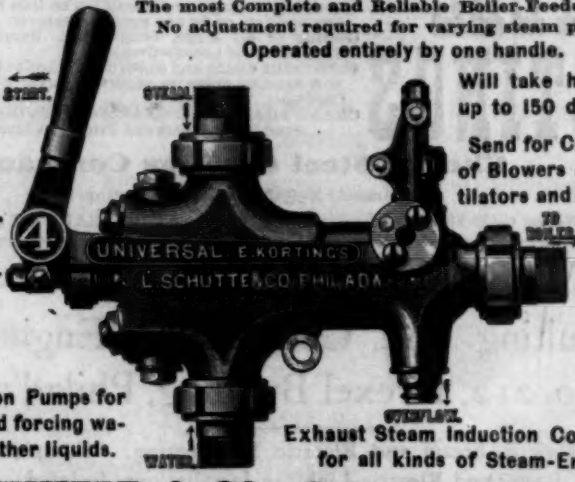

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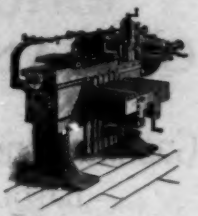

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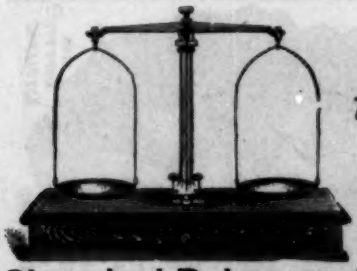

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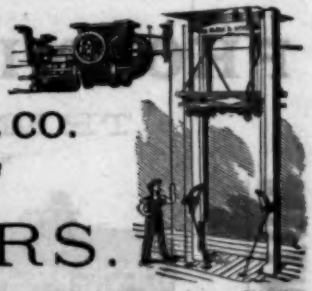

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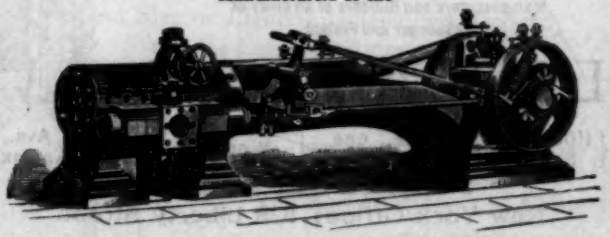
TRENTON  ENGINE

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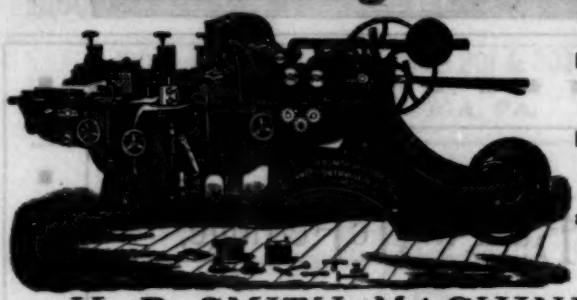

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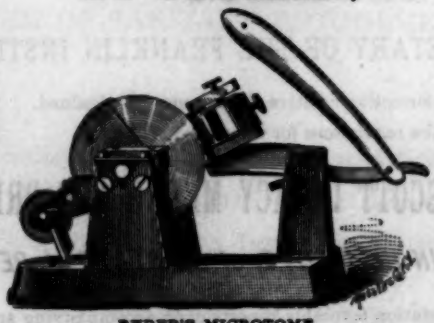

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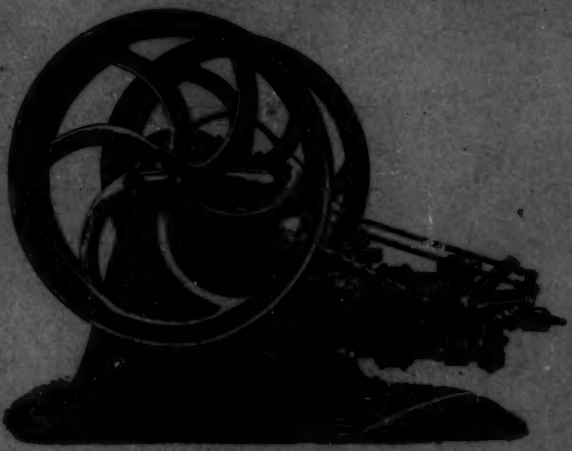

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